U.S. DEPARTMENT OF COMMERCE
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PB-255 147

REPORT FOR THE SUBCOMMITTEE ON ENERGY, NATURAL RESOURCES AND ENVIRONMENT OF THE SENATE COMMERCE COMMITTEE HEARING ON MERCURY CONTAMINATION UNDER THE DIRECTION OF SENATOR PHILLIP A HART, AT MOUNT CLEMENS, MICHIGAN, MAY 8, 1970

FEDERAL WATER QUALITY ADMINISTRATION

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SENATE COMMERCE COMMITTEE

HEARING ON MERCURY CONTAMINATION
UNDER THE DIRECTION OF SENATOR PHILLIP A. HART

AT
MOUNT CLEMENS, MICHIGAN
MAY 8, 1970

Prepared By

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
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May 1, 1970

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
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BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No. PB-255 147

4. Title and Subtitle Report for the Subcommittee on Energy, Natural Resources and Environment, of the Senate Commerce Committee Hearing on Mercury Contamination Under the Direction of Senator Phillip A. Hart, at Mount Clemens, Michigan, May 8, 1970

5. Report Date
1 May 1970

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Federal Water Quality Administration
Chicago, Ill.
Great Lakes Region

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts Partial Contents: Hazards of Mercury in the Environment with Special Reference to the Aquatic Habitat; Preliminary Report on Mercury Survey in St. Clair River to Lake Erie System; Miscellaneous Mercury Analyses in Lake Erie Basin; Economic Impact of the Current Mercury Pollution Problems in Lakes St. Clair and Erie; Inventory of Industries Using Mercury; Federa l-State Water Quality Standards and USPHS Drinking Water Standards for Mercury and Heavy Metals; Water Quality Standards, Federal Enforcement Procedures and the 1899 Rivers and Harbors Act; The Respective Roles of the States and Federal Government in the Enforcement of Water Quality Standards.

17. Key Words and Document Analysis. 17a. Descriptors

*Mercury(Metal)
*Water pollution
Great Lakes
Fishing grounds
Lake Saint Clair
Saint Clair River
Lake Erie
Lake Ontario
Detroit River
Surveys
Economic impact
Sediments
Sampling
Chemical analysis
Data

17b. Identifiers/Open-Ended Terms

*Great Lakes Region(United States)
Water pollution effects(Human)

17c. COSATI Field/Group 13B

18. Availability Statement National Technical Information Service, Springfield, Va. 22161	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 146
	20. Security Class (This Page UNCLASSIFIED	22. Price pc$6.00 mf$2.25

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SENATE COMMITTEE ON COMMERCE

Subcommittee on Energy, Natural Resources and the Environment

WITNESS LIST*

Hearing on the Effects of Mercury on Man and the Environment

Clinton Gables Hotel, Mt. Clemens, Michigan

Friday, May 8, 1970, 9:30 AM

Ralph Purdy, Executive Secretary, Michigan Water Resources Commission, Lansing, Michigan

William Click, Vice President, Inorganic Chemical Division, Wyandotte Chemical Company, Wyandotte, Michigan

J. J. Lankhorst, Ass't. Gen'l. Counsel, Army Corps of Engineers, Washington, D.C.

Dr. Albert C. Kolbye, Jr., Deputy Director Bureau Foods, Pesticides, and Product Safety, FDA, Washington, D.C.

C. B. Branch, Executive Vice President, Dow Chemical Company, Midland, Michigan

Francis Mayo, Regional Director, FWQA, Chicago, Illinois

* Not necessarily in order of appearance.

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MERCURY CONTAMINATION IN THE WATERS OF THE GREAT LAKES AND CONNECTING TRIBUTARIES

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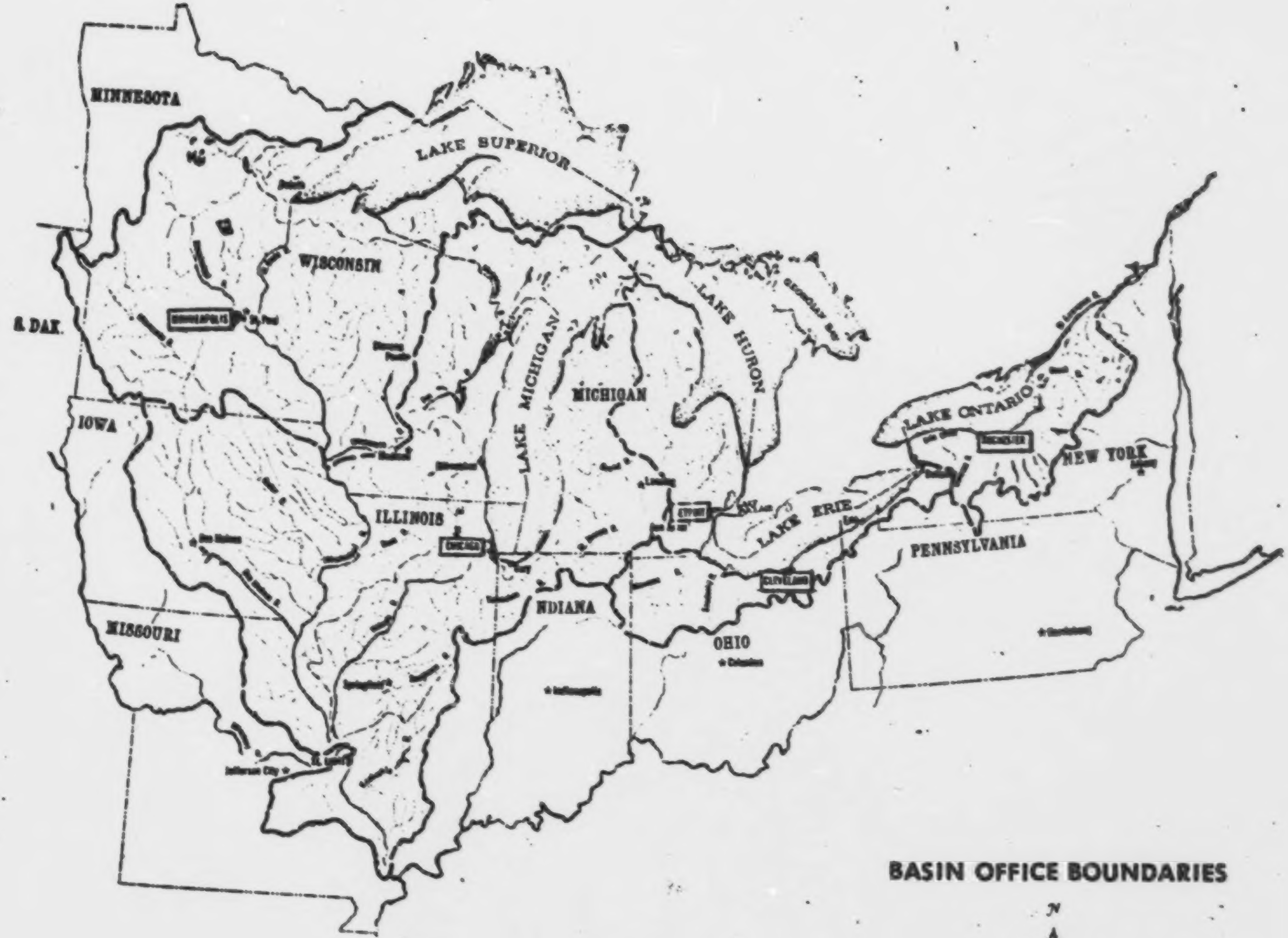
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MERCURY CONTAMINATION IN THE WATERS OF THE GREAT LAKES AND CONNECTING TRIBUTARIES

INTRODUCTION

Mercury is a metal, liquid at room temperature, which is used industrially as a cathode in the electrolytic preparation of chlorine and caustic soda. Large quantities are also used in electrical apparatus and industrial and control instruments. Significant quantities of mercury are used in dental preparation, as a catalyst, and in general laboratory applications. Compounds of mercury are used in insecticides, bactericides and fungicides for agricultural and industrial purposes. Pharmaceuticals, the control of slime in pulp and paper mills, and protective paints use mercury compounds. Uses that may become more important are catalysts in manufacturing organic compounds, pigments, and new applications of amalgam metallurgy. The relatively high toxicity of mercury and its compounds, together with the ability of biological magnification, is cause for concern where it is discharged to, or otherwise, reaches surface or ground waters.

As early as 1956 a report from Japan indicated that people were being poisoned by methylmercury. A plastic manufacturing plant in Minamata, Japan, a coastal town on the island of Kyushu, was discharging quantities of wastes containing mercury into Minamata Bay. Unsuspecting fishermen took their daily catch from the Bay home to their families. It was reported that between 1953 and 1960, 110 people, mostly from families of fishermen, were killed or severely disabled after eating fish caught in mercury-polluted waters. In the first eleven months of 1956, at the peak of the crisis, 42 people died after eating fish from Minamata Bay. At the end of 1956, fishing in the Bay area was banned. In 1958, fish were examined for mercury content to determine what levels of mercury were causing the poisoning. It was found that fish from Minamata Bay contained as much as 102 parts per million of mercury with an average of 50. Other subsequent incidents were reported from Japan.

In 1965, Swedish observers reported unusual concentrations in fish caught in the vicinity of pulp mills. Swedish pulp factories, which were using a mercury compound called phenyl mercury acetate (PMA) to prevent the growth of slime which clogs machines, discharged PMA with their wastewater. Early in 1966, Sweden banned the licensing of PMA. Some factories, however, had licenses expiring in 1968. It was reported in 1969 that mercury released from these factories could still be found in the bottom sediments of lakes, rivers, and coastal waters.

Critical mercury pollution in the Great Lakes became apparent on March 24, 1970, when the Canadian Government suspended commercial fishing in Lake St. Clair and impounded shipments of pickerel to the United States. Mercury concentrations as high as 5 parts per million (ppm) were reported in some of the fish analyzed. Two chlor-alkali plants in Sarnia, located on the Canadian side of the St. Clair River were first identified as sources of mercury contamination.

On April 2, 1970, the American Embassy at Ottawa, Canada, transmitted to the Secretary of State a telegram which contained the text of a note drawing attention to serious mercury contamination in certain boundary waters, principally Lake St. Clair. An appropriate response was prepared by representatives of the Departments of State, Interior and Health, Education and Welfare.

As a result of the announcement by Canadian Federal Department of Fish and Forestry, coordination was initiated by the Federal Water Quality Administration among the States of Michigan and Ohio, Ontario Water Resources Commission, Bureau of Commercial Fisheries, Bureau of Sport Fisheries and Wildlife and the Food and Drug Administration to obtain a better understanding of the mercury problem. On the United States side, a State and Federal water and sediment and fish sampling program was immediately initiated in the St. Clair River, St. Clair Lake, Detroit River and Western Lake Erie. Preparations were made to sample Lake Ontario, Superior and Michigan. Continuing documentation of the presence of mercury in fish and bottom sediments in these bodies of water confirms the existence of an international and interstate environmental problem of major scope. This report deals with the findings of the United States investigation, primarily the investigations conducted by the Federal Water Quality Administration and Bureau of Commercial Fisheries.

SUMMARY OF FINDINGS

Investigations of mercury pollution sources and water sediment and fish sampling continue. Information collected thus far by Canadian and United States agencies supports action taken to ban commercial fishing in the St. Clair River, Lake St. Clair, Detroit River and Lake Erie.

Fish

Mercury has been detected by Bureau of Commercial Fisheries (BCF) in fish collected in Lake St. Clair and the western basin of Lake Erie since March 28, 1970. Any mercury is considered unacceptable for human consumption. Data acquired by the Bureau of Commercial Fisheries covering mercury concentrations for fish caught as late as April 1, 1970, are shown in Appendix IV. In Lake St. Clair, walleye caught on March 28, 1970, contained as much as 2.0 ppm mercury. Reports 1 through 3, Appendix IV, show that for the period March 28 to April 1, 1970, mercury concentrations in all fish caught in Lake St. Clair varied from 0.80 to 2.0 ppm. In Lake Erie, white bass caught on March 30, 1970 contained as much as 1.0 ppm mercury. For the period of March 28 to April 1, 1970 mercury concentrations in fish caught in Lake Erie varied from 0.08 to 1.0 ppm. Data on walleye taken during the same period and from the same area are not complete; however, preliminary investigation indicates mercury concentrations will be of the same magnitude or greater as for white bass.

Additional samples are currently being collected by BCF from the central basin of Lake Erie, from southern Lake Huron and Saginaw Bay, and from the southeast section of Green Bay.

An informal survey of the fish industry by BCF reflects that total fish sales from all sources in the midwest have been reduced about 15 percent since the mercury ban was announced, and it is anticipated that midwest sales of lake perch could be reduced by 50 percent over the course of the 1970 season.

Water

Mercury concentrations of waters sampled by FWQA in the St. Clair River, Lake St. Clair, Lake Erie and Lake Ontario were all below detectable levels of the test. One of the samples collected by FWQA just below the Wyandotte Chemical Company outfall in the Detroit River contained 0.03 ppm mercury.

Sediments

In the Great Lakes, mercury concentrations as high as 86 ppm in bottom sediments have been recently found in areas sampled by FWQA. The 86 ppm mercury was found in a narrow strip along the United States shoreline in the Trenton Channel of the Detroit River within a mile below the Wyandotte Chemical plant outfall. Concentrations as high as 170 ppm have been found in the discharge ditch of the Detrex Chemical plant in Ashtabula, Ohio which discharge to Lake Erie. The Michigan Water Resources Commission has reported finding 430 ppm mercury in sediments below the outfall of the General Electric Company plant at Edmore, Michigan which discharges to the Tittabwassee River. Mercury concentrations in sediments contribute to the contamination of fish and other aquatic life.

Sources of Contamination

Certain chlor-alkali plants using mercury have been identified as sources of mercury contamination (See Table I, Appendix V). On the United States side of the Great Lakes, losses to water have ranged up to 66 pounds per day. While the chlor-alkali

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plants appear to be a major source of mercury contamination, other sources such as vinyl chloride manufacturers, paper mills using mercury slimicides, felt manufacturers and mercury producers are potential sources of mercury contamination. Also implicated in mercury contamination are runoff of agricultural mercury-based pesticides, antifouling paint formulations and mercury-containing products for home use.

PROGRAMS

The Secretary of the Interior indicated on April 21, 1970 that the Department of the Interior is initiating a massive compaign to clean up Lake Erie, following reports of lethal discharges of mercury into the Lake and into the Detroit River which empties into Lake Erie.

The following actions will be taken:

An enforcement conference on Lake Erie will be reconvened in Detroit, followed by enforcement workshops in Toledo, Cleveland, Lorain, Sandusky, and Ashtabula, Ohio, Erie, Pennsylvania, and Lackawanna, New York.

The Secretary's special investigative task force has been assigned to obtain firsthand up-to-date data on the entire water pollution problem in the Lake Erie watershed.

Increased monitoring and research will be initiated a the Fish and Wildlife Service's Great Lakes Fishery Laboratory at Ann Arbor, Michigan, on the toxicity of mercury and other metal compounds and their effect on fish and other aquatic life.

The Federal Water Quality Administration has been directed to identify and prepare a list of all toxic substances now being discharged in waters throughout the United States.

APPENDIX I

HAZARDS OF MERCURY IN THE ENVIRONMENT WITH SPECIAL REFERENCE TO THE AQUATIC HABITAT

Introduction

During the last two decades international attention has been focused on hazards from mercury contamination of the environment in Japan and Sweden. During 1953-1960, 111 persons were killed or severely disabled in Minamata, Japan. A second poisoning accident occurred in Niigata, Japan during 1965. Mercury poisoning caused a drastic decrease of many bird populations in Sweden. Subsequently, it was found that freshwater fish in Sweden contained large amounts of mercury. In these instances, methyl mercury was the form of mercury most commonly involved.

Although much of the data on the toxicity of methyl mercury are incomplete, ample evidence exists demonstrating that methyl mercury is extremely toxic and hazardous to living systems, including man. Löfroth pointed out in 1969: "Up to now every new result presented seems to point out that methyl mercury is more hazardous than considered earlier." It is obvious from the published data that mercury in many different forms can be toxic. The "Report of an International Committee" (1969) on the maximum allowable concentration of mercury compounds, however, points out that the methyl and ethyl mercury salts are by far the most toxic.

Toxicity

EFFECTS ON MAN

The symptoms in man of poisoning from alkyl mercury compounds are described in the "Report of an International Committee" (1969) on maximum allowable concentrations of mercury compounds are as follows:

> "Symptoms of methyl and ethyl mercury poisoning may occur weeks to months after an acute exposure to toxic concentrations. The symptomatology of acute and chronic poisoning from both compounds is similar, including numbness and tingling of the lips of hands and feet, ataxia, disturbances of speech, concentric constriction of the visual fields, impairment of hearing, and emotional disturbances. With severe intoxication the symptoms are irreversible. The first epidemic of intoxication by ingestion of contaminated fish occurred in the Minamata district in Japan and, therefore, this type of intoxication is often called Minamata disease.
>
> In infants born to mothers with exposure to large amounts of methyl mercury, the symptoms are somewhat different, as would be expected. Most children had mental retardation and also cerebral palsy with convulsions."

One characteristic of methyl mercury is its tendency to accumulate in the human brain. According to the International Committee's Report: "experiments in man with very small doses have shown that about 15 percent of the total body burden of methyl mercury is accumulated in the brain." Suzuki (1969) found that neurological symptoms manifest themselves in man when the brain contains a concentration of about 20 µg/g of mercury of wet tissue.

Löfroth (1969) also noted that: "one of the observable effects of methyl mercury poisoning in man is the impairment of the coordination of muscle movement, etc., resulting from damage to certain brain cells. Thus Löfroth raises the question: "whether these effects are brought about only at and above some threshold value of methyl mercury intake." He further states: "As to the gross clinical symptoms one can state that a threshold mechanism is operating. This threshold mechanism is, however, not due to a methyl mercury threshold, but to a threshold in the number of damaged brain cells. After damage of one or a few cells, other cells may take over the net result showing up as no effect in the clinical investigation. When too many cells have been damaged during a short time, the clinical results do show up early. This type of mechanism can erronelously be classified as a methyl mercury threshold mechanism." He also states: "however, even a low frequency of brain cell damage, above the natural inactivation rate of these cells, during a long time has an effect on the organism as the number of available cells for each brain function is limited. Such a damage may then, have serious effects in later stages of life."

The present appearance of health in a person exposed to methyl mercury may not rule out the fact that his residual growing capacity could be lowered.

The reduction in residual brain capacity can occur in the pre-natal stages. According to Löfroth (1969), the human fetus acquires higher mercury concentrations than the mother-to-be, so that infants with congenital brain damage from methyl mercury are born to mothers who show no symptoms of methyl mercury poisoning. The "Report of an International Committee" (1969) states: "studies in animals and man indicate that methyl mercury easily penetrates to the fetus via the placenta. The concentration of mercury in the fetal blood is about 20 percent higher than in the mother and the same statement should apply to the brain of the fetus as well." Thus, the human fetus may be affected by methyl mercury poisoning, when the mother-to-be is exposed to levels of the compound several times less than the intake affecting a non-pregnant woman. The International Committee's report further states: "In Minamata area, Kumamoto prefecture, Japan, there were 22 infants with evidence of damage born during the years 1955 to 1959, out of a total of approximately 400 births. High values of mercury in the hair were registered in some of these mothers and children. Most of the mothers experienced numbness during pregnancy and all of them were heavy fish consumers, although most of them had no symptoms typical of Minamata disease."

Effects on Fish and Wildlife

McKee and Wolf (1963) summarized the effects of mercuric chloride, mercuric cyanide, mercuric nitrate, mercuro-organic compounds and mercury on aquatic life. Their summary is quoted below:

"MERCURIC CHLORIDE

Fish and Other Aquatic Life. From a study of the relation between concentration of the salt and period of survival, it appears that mercuric chloride is infinitely toxic to fish, i.e. that infinitesimal traces of the compound will be toxic if exposure continues long enough(3547). The following concentrations of mercuric ion from chloride have been shown to injure or kill fish in the time indicated:

Concentration of Mercury, in mg/l	Time of Exposure	Species of Fish	Reference
0.008	--	sticklebacks	1460,2941
0.01	--	sticklebacks	2962,2920
0.01	80-92 days	minnows	1459
0.011	--	sticklebacks	598
0.02	--	guppies	2921
0.02	19-47 days	minnows	1459
0.02	7 days	sticklebacks	1460
0.027	50 hours	young eels	1459
0.05	1 day	minnows	1459
0.1	8 hours	minnows	1459
0.2	4 days	sticklebacks	1459
3.2	--	minnows	362
4.0 to 30	--	fish	468
7.4	15 minutes	sticklebacks	1459
7.4	106 minutes	sticklebacks	1264
9.2 to 37	24 hours	trout	359
10.0	42 minutes	minnows	313
12.6	15 minutes	minnows	362
30	31 minutes	fish	467
370	54 munutes	trout	313
1000	20.5 minutes	minnows	991
5000	12 minutes	minnows	991

* Threshold value for detrimental effect

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In varying concentrations, sodium chloride exhibits first a synergistic effect, then an antagonistic effect toward the toxicity of mercuric chloride. The presence of 1,000 mg/l of NaCl decreased the survival time of fish in a solution of 10mg/l of mercuric chloride from 106 minutes to 54 minutes, but concentrations of 15,000 mg/l of NaCl prolonged the survival time to as much as 190 minutes (1264, 1265). According to Jones (467), fish show no special ability to detect or avoid toxic concentrations of mercuric chloride.

Anderson (598) reports that the threshold concentration for immobilization of *Daphnia magna* in Lake Erie water at 25°C was found to be less than 0.006 mg/l in 64 hours. For *Polycelis nigra*, a flat worm, the threshold of toxicity in 48 hours was 0.2 mg/l of mercury, or 0.027 mg/l of mercuric chloride, according to Jones (608). The effect of mercuric chloride on *Marinogrammarus marinus*, an amphipod, was measured by Hunter (1266) who found that 0.1 mg/l of mercury killed in 510 minutes and 1.0 mg/l in 390 minutes. Low concentrations of copper increase appreciably the toxicity to mercury solutions.

Toward the larvae of bivalves, Woelke (2989) reported mercuric chloride to be lethal at a concentration of 0.027 mg/l (0.02 mg/l as Hg). Bringmann and Kuhn (2158,3343), using River Havel water, determined the concentrations of mercury added as mercuric chloride that produced threshold effects upon four organisms as follows:

Organism	Threshold Concentration of Hg in mg/l
Microregma	0.15
Escherichia coli	0.2
Scenedesmus	0.03
Daphnia magna	0.03

In a concentration of 3.0 mg/l, mercuric chloride killed 100 percent of water snails (Australorbis glabratus), while at a dosage of 1.0 mg/l only 30 percent were killed (exposure time not specified) (3548). Other inorganic mercury salts were approximately equal in effectiveness.

Mercuric chloride at a concentration of 0.61 mg/l causes a 50 percent decrease in the 5-day utilization of oxygen by synthetic sewage (2923) and at a concentration of 2.0 mg/l there is complete bacteriostasis (3549).

Clendenning and North (2106, 2107) found that 0.05 mg/l of mercury, added as mercuric chloride, caused a 50-percent inactivation of photosynthesis of the giant kelp (Macrocystis pyrifera) during a four-day exposure, while 0.1 mg/l caused a 15-percent decrease in photosynthesis in one day and complete inactivation in four days. Mercury was more toxic than copper, hexavalent chromium, zinc, nickel, and lead.

MERCURIC CYANIDE $Hg(CN)_2$

Highly soluble in water, mercuric cyanide has been used as a diuretic, as a topical antiseptic, and as a disinfectant for surgical instruments (364). Bringmann and Kuhn (2158,3343) tested its effectiveness in water from the River Havel toward four organisms. Concentrations of mercury

2'

added as Hg $(CN)_2$ required to cause a median threshold effect were reported as follows:

Organism	Threshold Concentration of Hg in mg/l
Daphnia magna	0.02
Scenedesmus	0.15
Escherichia coli	0.20
Microregma	0.16

MERCURIC NITRATE $Hg(NO_3)_2 \cdot H_2O$

This soluble salt is used in the manufacture of explosive caps, felt, and the treatment of skin diseases. In very soft water, it killed sticklebacks in one week at a concentration of 0.02 mg/l as Hg (2977). Toward guppies the LD_{50} value was also reported as 0.02 mg/l as Hg (2921). A concentration of 3.0 mg/l gave a 90 percent mortality among water snails, while 1.0 mg/l showed a 30 percent reduction (3548). Klock and Pearson (2314) reported the 48-hour TL_m toward the stickleback (Gasterosteus aculeatus) as 1.7 mg/l. The concentrations producing the first apparent significant response for three organisms were as follows:

Test Species	Concentration of $Hg(NO_3)_2$ in mg/l
Isopod (Neospheroma oregonensis)	0.015
Fish (Gasterosteus aculeatus)	0.015
Polychaete (Mercierella enigmatica)	1.00

MERCURO-ORGANIC COMPOUNDS

Organic mercury compounds are used in herbicides, fungicides, and medical treatment of animals and humans. They have been used extensively to control slimes in paper mills and consequently they may be present in discharged white waters. Phenylmercuric acetate is used extensively as a herbicide for the control of crabgrass.

Van Horn (974) tested the survival time of fish in organic mercury compounds and other proprietary substances used for slime control in paper mills. He found that the critical concentrations, i.e., the concentrations that will sooner or late be fatal to fish, were as follows:

Trade Name	Concentration in mg/l for	
	Minnows	Shiners
Santobrite	0.3 to 0.4	0.2
Merfenel	0.02	0.02 to 0.06
Lignasan	1.0	0.8
Nalco 23	1.4	1.4
Nalco 21	--	0.4

Van Horn and Balch (3550) investigated the toxicity of slime control agents to minnows. The minimum lethal concentration was 0.15 mg/l for pyridylmercuric acetate and 0.04 mg/l for pyridylmercuric chloride.

Ellis (1267) found that in water at a pH value of 7.7 to 7.8 containing 0.5 mg/l of phenylmercuric lactate, all fish died in 16 hours or less. The lowest concentration causing death was about 0.10 mg/l. In terms of the content of mercury, phenylmercuric lactate is more than twice as toxic as mercuric chloride.

Phenylmercuric acetate (Scutl) in concentrations of 0.02 mg/l was fatal to young salmon in less than five days, according to Vallin (357), and the maximum safe concentration was found to be 0.01 mg/l. For mercuric acetate, the safe concentration was 0.02 to 0.05 mg/l. Daphnia pulex was found to be more sensitive than fish to phenylmercuric acetate, the safe concentration lying between 0.005 and 0.01 mg/l.

Pyridylmercuric acetate in very small concentrations (about 0.14 mg/l) was found to be beneficial to the health of fish, probably by suppressing the micro-organisms in the water (356). According to Van Horn and Katz (1268), 96 percent of Lake Emerald shiners survived a concentration of 0.15 mg/l but higher concentrations are toxic to fish.

Pyridylmercuric acetate successfully controlled the growth of a flourescent species of Pseudomonas, which had infected yearling blueback salmon, when the fish were immersed for one hour in a solution containing 10 mg/l without harming the fish (1598). This same concentration, however, has been found toxic to other species, being more toxic to rainbow trout fingerlings than to brown or brook trout. Toxicity was manifested by losses of appetite, and it increased with temperature (1599).

A concentration of 5 mg/l for one hour was not toxic to rainbow trout fingerlings less than three inches in length, but it was toxic to larger fingerlings of the same species (1467). A concentration of 2 mg/l applied for one hour to yearling trout resulted in the death of 13 percent of the fish. Two weeks later a repeated treatment caused death of 10 percent of the fish. No fish died after a third treatment when the fish were not fed for 24 hours (1600).

Clemens and Sneed (2 81) investigated the toxicity toward fingerling channel catfish of numerous compounds used in fish management and in agriculture. The results for organic mercury compounds in tap water are summarized below:

Chemical	Temperature °C	TL_m in mg/l 24 hrs.	48 hrs.	72 hrs.	96 hrs.
Phenylmercuric acetate	19	4.1	3.4*	3.3	3.3
Pyridylmercuric acetate	24	3.8	--	0.49	--
Ceresan M (a)	19	1.8	1.8	1.6	1.6
Lignasan (b)	19	2.0**	2.2	1.7	1.3
Tag 10% solution (c)	20	1.5	0.78	0.60	0.58

* At 45 hours
** At 28 hours
(a) Ethyl mercury p-toluene sulforanilide, 7.7 percent (total mercury as metallic, 3.2 percent)
(b) Ethylmercuric phosphate, 6.25 percent
(c) Phenylmercuric acetate, 10 percent

Bond and Nolan (3548) found that 13 organic compounds of mercury were 90 to 100 percent fatal to snails (Australorbis glabratus) at concentrations of 1.0 mg/l and several were highly toxic at 0.3 mg/l. Toward phytoplankton, the minimum lethal concentration of ethylmercuric bromide, phenylmercuric chloride, and ethylmercuric oxalate was found to be about 0.3 mg/l. Zooplankton were killed by this concentration in 22 minutes (3552). Lignasan (ethylmercuric phosphate, 6.25 percent) is an effective algicide at 1.0 mg/l (3551).

MERCURY

Fish and Other Aquatic Life. Mercuric ions are considered to be highly toxic to aquatic life. For freshwater fish, concentrations of 0.004 to 0.02 mg/l of Hg have been reported harmful (2409). For the stickleback (Gasterosteus aculeatus) the lethal concentration limit has been found to be 0.008 mg/l (353,1460,2941). Mercury salts, such as the unstable compounds mercuric sulfate and nitrate, have killed minnows at a concentration of 0.01 mg/l as mercury, after 80-92 days. At concentrations of 0.05 and 0.1 mg/l as mercury, fish were killed in 6 to 12 days (1459). For further details, see the mercuric salts.

In contrast, Schweiger (2151) reported that 0.2 mg/l of mercury was not harmful to one- and two-year-old tench, carp, rainbow trout, and char, nor to fish-food organisms such as crustacea, worms, and insect larvae.

For phytoplankton, the minimum lethal concentration of mercury salts has been reported (3552) to range from 0.9 to 60 mg/l of Hg. The toxic effects of mercuric salts are accentuated by the presence of trace amounts of copper (3313).

The Severn and Mersey River Boards in England have adopted working standards that limit the total concentration of heavy metals, including mercury, to 1.0 mg/l (1765,2950).

BIRDS

Fatalities to birdlife from eating seeds treated with methyl mercury are well known and documented. In addition Johnels and Westermark (1969) found that fish-eating birds can be affected by eating mercury contaminated fish.

Teratogenicity and Mutagenicity

The "Report of an International Committee" (1969) on maximum allowable concentrations of mercury compounds states: "Cytological investigations on plant and animal cells have shown that mercury compounds give rise to chromosome breakage and act as inhibitors of the mitotic spindle mechanism with the result that polyploidy or abnormal distribution of single chromosomes occur. As spindle inhibitors, methyl and phenyl mercury compounds are more potent than any other substance known, including colchicine. Inorganic mercury is about 200 times less potent." The report further states that it has been demonstrated in the fruit fly consuming food with .25 ppm methyl mercury will give rise to offspring carrying one extra chromosome. Ramel (1967) showed that methyl mercury had considerable potency as a mitosis-disturbing compound on root cells of Allium Cepa causing polyploidy and chromosome disjunction. He concluded from his study that the organic mercury compounds constitute the most efficient c-mototic agent that is known.

According to the International Committee's report, the data from the Minamato cases in Japan indicate teratoxenic effects occurring at an earlier stage of development than would be the case of the central nervous system damage from methyl mercury intoxication. The report states: "Because of the experimental evidence of strong effects of methyl mercury compounds on cell division and chromosome segregation, it is conceivable that this early effect may have resulted from induced chromosomal alterations of humans. According to Lofroth (1969), Frolen and Ramel found that methyl mercury treatment on the 10th day of pregnancy resulted in a higher frequency of reabsorped litters and increased percentage of dead fetuses in mice. Even though the injected doses were appreciably below the lethal level for the adult animals, the fetuses were greatly affected.

Conversion of Mercury Compounds

Jernelov (1969) reviewed the conversion of mercury compounds and the reader is referred to his paper.

Mercury is usually discharged to the environment in one of the following forms:

1. As inorganic divalent mercury, Hg^{2+};
2. As metallic mercury, Hg^0;
3. As phenyl mercury, $C_6H_5Hg^+$;
4. As methyl mercury, CH_3Hg^+; and
5. As alkoxi-alkylmercury, $CH_3O\text{-}CH_2CH_2\text{-}Hg^+$.

Metallic mercury can be oxidized readily to divalent mercury ions under conditions present at the bottoms of lakes and rivers, and this has been shown to occur experimentally as well. The divalent inorganic mercury produced has an extremely strong affinity for organic muds and experimentally it has been shown that it is biologically methylated in the bottom sediments. Jernelov (1969) states that in Sweden investigations have been made of sediments from a large number of lakes and rivers regarding the occurance and rate of methylation of mercury. In all cases, microrganisms capable of methylating mercury have been present in the sediments.

Divalent inorganic mercury when methylated is readily released from the sediments into the water. The speed of the methylating process under anaerobic conditions can sometimes be very high. (Jernelöv; 1969). It appears that the methylation of mercury is enhanced under anaerobic conditions, which means that organic enrichment of water may increase the rate with which methyl mercury if formed. (Jernelöv, 1969). Jernelöv (1969) also states that the conversion of phenyl mercury to methyl mercury has been studied and shown to occur in nature. He further states that: "observations in nature repeatedly indicate that the discharges of phenly mercury has a stonger and faster effect of mercury concentration in the fish than the discharge of a similar amount of inorganic mercury." Jernelöv (1969) further asserts that the conversion of alkoxi-alkylmercury to inorganic divalent mercury is well known to occur.

Westoö (1970) states that in Sweden, regardless of the nature of the mercury pollutant, only methyl mercury has been found in fish indicating that a methylazation of mercury compounds takes place in the fish itself. Jernelöv (1970) found that the mucus on pike is able to convert inorganic bivalent mercury almost completely into methyl mercury within a short period of time of 2 to 4 hours.

Thus, it appears that no matter what form of mercury is introduced into the aquatic environment it eventually can be converted to the most toxic form -- methyl mercury.

Biological Accumulation of Mercury

Terrestrial animals usually accumulate mercury taken in with their food. However, it has been demonstrated that fish in the aquatic environment can accumulate mercury directly from the surrounding water, although food may also play a role. Johnels _et al_. (1967) demonstrated that the concentration factor from water to pike is in order of 3,000 or more. Johnels and Westoö (1969) pointed out that fish-eating birds accumulate mercury from eating contaminated fish. According to Lundaholm (1967), studies in Sweden have revealed that the highest values of mercury are obtained from muscle tissues of fish, and Noren and Westoö (1970) found that broiling, boiling or frying fish did not remove the methyl mercury. Some of the possible ways man can accumulate mercury are from eating contaminated fish and other contaminated foods, as well as from drinking contaminated water.

3

Safe Limits for Mercury

Drinking water standards of the U.S. PHS and WHO do not include limits for mercury. However, for over a decade the maximum premissible concentration of mercury or mercuric ions in the USSR has been .005 ppm. The official Swedish limit for mercury in fish is one mg/kg (Lofroth 1969). Lofroth (1969) states that the official one mg/kg limit for mercury has been widely criticized by scientists as being too high for Sweden. He further points out that: "An upper maximum acceptability limit for methyl mercury of .2 mg Hg/kg wet fish tissue has been suggested by a Swedish toxicologist after elaborate studies and considerations. The official Swedish legal limit of one mg Hg/kg is amended, however, with the recommendation to limit consumption of fish to one meal a week. The later evaluation has been reached after balancing different toxicological and economic interests." Lofroth (1969) concluded that at least in Sweden, from the maximum natural concentration of mercury in fish never exceeds 200 mg/g fresh weight.

Decontamination of Lakes

According to Lofroth (1969) mercury contamination of fish at high concentrations does not cease when the discharge of mercury pollutants stops. In Sweden the pollution may last for 10-100 years unless the mercury is made inactive either by physical removal or by elimination of biological availability.

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APPENDIX II

CHRONOLOGY OF EVENTS

March 24, 1970

The Canadian Federal Department of Fish and Forestry banned the sale and export of fish caught commercially within the Canadian boundaries of Lake St. Clair because concentrations of mercury in some of the fish made them unfit for consumption. The decision was made as a result of a research report which showed pickerel caught in the lake contained as much as seven parts per million mercury (ppm). Subsequent laboratory reports indicated a somewhat lower figure of 1.36 ppm which, however, is still almost three times as great as 0.5 ppm level considered acceptable for fish procured for export by federal food and drug authorities in both Canada and the United States. The Ontario Water Resources Commission identified two Dow Chemical of Canada Limited chlor-alkali plants at Sarnia, Ontario as the source of mercury pollution to the St. Clair River.

FWQA Regional Office learned from Mr. Ralph Purdy, Executive Secretary, Michigan Water Resources Commission, that he had written letters to chlor-alkali plants in the state to find out who was using mercury cells. He reported that the Wyandotte Chemical Company on the Detroit River uses mercury cells and that he was conducting discussions with them to learn about the disposition of their mercury bearing wastes.

March 26, 1970

Coordination achieved with Michigan agencies, Ontario Water Resources Commission, Bureau of Commercial Fisheries, and Food and

Drug Administration. FWQA Lake Huron Basin Office initiates a water and sediment sampling program for the St. Clair River, Lake St. Clair, Detroit River, and Western Shore of Lake Erie. Advised that Field staffs of the Bureau of Commercial Fisheries, Great Lakes Fisheries Laboratory, Ann Arbor, and the Department of Natural Resources, would be conducting a fish sampling program and that arrangements were being made for the Wisconsin Alumni Research Foundation (WARF), Madison, Wisconsin to analyze the fish samples. Learned that the Michigan Health Department and the Michigan Water Resources Commission were getting samples from water intakes, treatment plants and industrial outfalls for analyses of mercury at the Lansing laboratory.

March 27, 1970

FWQA Lake Huron Basin Office begins collecting water and sediment samples from the Wyandotte Chemical plant.

April 2, 1970

Regional Director, GLR, chaired an informal meeting at FWQA Headquarters, Washington, D. C., with Bureau of Commercial Fisheries, Bureau of Sports Fisheries and Wildlife, Food and Drug Administration, and Ontario and Canadian Federal representatives. The meeting was called to obtain a better understanding of the mercury problem and to exchange information. It was the consensus of the representatives present that the mercury problem is serious and of international concern. It was also agreed that an inventory of mercury uses to determine waste concentration was needed and that sampling should continue in order that the problem may be completely defined.

6

April 8, 1970

Governor Milliken of Michigan advises sportsmen not to eat fish caught from Lake St. Clair and the Detroit and St. Clair Rivers.

April 10, 1970

A meeting of Ontario, Michigan, and Ohio representatives was held in Toronto, Ontario to share information and explain how decisions were reached for Ontario to place a ban on fishing in Lake St. Clair, St. Clair River, and Detroit River. Federal people from Canada and the United States were invited as observers. Mr. O'Leary of the Lake Huron Basin Office, represented the FWQA Great Lakes Region at the meeting.

Rperesentatives of all agencies agreed that sampling and testing must continue in order that the problem may be completely defined.

Mr. Kerr, Federal Energy and Resources Minister, described the action that has been taken to halt any further mercury discharge from the presently known source of pollution on the Canadian side of the boundary in this area, and Governor Milliken stated that he had received an assurance today that the presently known source on the Michigan side had today instituted procedures to eliminate future mercury contamination of the water from its facility.

It was agreed that future action will be taken in a coordinated way so that all involved agencies may take similar action.

The representatives of the States of Ohio and Michigan agree with those from Ontario that a ban on fishing in Lake Erie is not indicated at this time. Their respective agencies agreed to exchange information from their sampling and testing programs.

Governor Milliken announced the following actions and agreements:

1. Michigan will institute proceedings to close Lake St. Clair and the St. Clair River to all fishing as a precautionary measure pending further study;

2. Michigan, Ontario, Ohio FDA and the U. S. Federal Water Quality Administration agreed to cooperate in developing further information on the Detroit River and Lake Erie;

3. Participants in the meeting agreed to continue and accelerate efforts to eliminate mercury contamination from all sources;

4. All parties agreed to consult with various other authorities prior to taking actions affecting waters of the Great Lakes;

5. All parties agreed to participate, with other authorities, in investigating additional dangerous substances as to kinds, amounts and effects;

6. All parties agreed to recommend the convening of a conference of the Governors and Prime Ministers of the Great Lakes States and Provinces;

7. All parties agreed to urge all respective federal bodies to initiate actions to investigate sources of mercury contamination in all states and provinces.

8

Ohio Department of Health determines Detrex Chemical Company of Ashtabula, Ohio a probable source of mercury contamination.

FWQA Lake Erie Basin Office, Cleveland initiates a water sampling program in Lake Erie and tributaries and participates in an inspection of the Detrex Chemical Company plant.

Wyandotte Chemical plant ceased mercury waste discharges to the Detroit River at 12:30 p.m. Mercury enriched waters are now being discharged in holding facilities for chemical treatment.

April 13, 1970

Governor Rhodes of Ohio announced a ban on commercial fishing in Lake Erie.

Ohio Water Pollution Control Board issued a "cease and desist" order to Detrex Chemicals Company.

FWQA Lake Huron Basin Office personnel met with Michigan State officials. The MWRC agreed to supply one man to aid in the field work collecting sediment samples and to share duplicate samples for verification purposes. MWRC to continue sampling effluents in the area.

April 14, 1970

FWQA Great Lakes Region Basin Offices provided with a list of chlor-alkali plants and asked to investigate as sources of possible mercury pollution.

April 16, 1970

The Wyandotte Chemical Company was issued a court order to cease discharges of mercury wastes in any form or amount. The plant ceased operation of the mercury cell room at 6:20 p.m.

April 21, 1970

Secretary of the Interior Walter J. Hickel announced his Department is initiating a massive campaign to clean up Lake Erie, as a result of reports of lethal discharges of mercury into the Lake and into the Detroit River which empties into Lake Erie.

In a series of steps, Secretary Hickel announced taking the following action:

— An enforcement conference on Lake Erie will be reconvened in Detroit, followed by enforcement workshops in Toledo, Cleveland, Lorain, Sandusky, and Ashtabula, Ohio; Erie, Pennsylvania; and Lackawanna, New York.

— The Secretary's special investigative task force has been assigned to obtain firsthand up-to-date data on the entire water pollution problem in the Lake Erie watershed.

-- Increased monitoring and research will be initiated at the Fish and Wildlife Service's Great Lakes Fishery Laboratory at Ann Arbor, Michigan, on the toxicity of mercury and other metal compounds and their effect on fish and other aquatic life.

— The Federal Water Quality Administration has been directed to identify and prepare a list of all toxic substances now being discharged in waters throughout the United States.

April 23, 1970

Assistant Secretary for Water Quality and Research, Carl Klein, directed the Commissioner, FWQA, to take necessary immediate action to translate the Secretary of the Interior's announcements of April 21 into positive action. He also asked that the Task Force assigned to obtain firsthand up-to-date data on the entire water pollution problem in Lake Erie and coordinate with Michigan, New York, Ohio and Pennsylvania.

April 29, 1970

Prime Minister John P. Roberts of Ontario called a conference for June to discuss pollution problems in Lake Erie. The Prime Minister invited the Prime Minister of Quebec and the Governors of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin.

April 30, 1970

-- Governor Rockefeller of New York announced that the Department of Agriculture and Markets began placing all fish caught commercially in Lake Erie under seizure to protect consumers from mercury contamination. The Department of Conservation advised sports fishermen against eating fish taken from Lake Erie. This action was taken after analysis of several New York fish samples showed levels of mercury in excess of 0.5 ppm considered acceptable for sale by the Food and Drug Administration. The Governor announced that the State Health Department also had tested drinking water taken from Lake Erie and that it had been found fully safe for human consumption.

Staff members of the FWQA Great Lakes Region met with members of the Secretary of the Interior's Task Force to develop plans for action required to implement the Secretary's announcement of April 21. Recommendations for appropriate field investigations and research projects were developed for Headquarters' consideration.

//

APPENDIX III

FWQA INVESTIGATIONS

1. Preliminary Report on the Mercury Survey in the St. Clair River to Lake Erie System
2. Miscellaneous Mercury Analyses in Lake Erie Basin
3. Preliminary Report on Mercury Investigations at Detrex Chemicals Corporation, Ashtabula, Ohio
4. Lake Ontario Basin Office Mercury Analyses - Water

Reproduced from best available copy.

APPENDIX III

PRELIMINARY REPORT
ON THE
MERCURY SURVEY
IN THE
ST. CLAIR RIVER TO LAKE ERIE SYSTEM

FEDERAL WATER QUALITY ADMINISTRATION
LAKE HURON BASIN OFFICE

May 1, 1970

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MERCURY SURVEY IN THE ST. CLAIR RIVER TO LAKE ERIE SYSTEM

Introduction

This report has been prepared to present the information collected and compiled to date by the Federal Water Quality Administration (FWQA), Lake Huron Basin Office during the mercury investigations. The information focuses on the main source of mercury in the U.S. waters of the Detroit River, namely, the Wyandotte Chemicals South Works in Wyandotte, Michigan, and the levels of mercury contamination in the area between and including the lower St. Clair River and western Lake Erie.

Summary and Conclusions

1. The FWQA-Lake Huron Basin Office in cooperation with the Michigan Water Resources Commission (MWRC) and other public agencies has conducted surveys of mercury contamination in the waters and sediments between and including the lower St. Clair River and western Lake Erie.
2. The Wyandotte Chemicals Corp. South Works is the major mercury user in the U. S. portion of the survey area. The plant historically has consumed about 80 lbs/day of mercury and about 10-20 lbs/day has been discharging to the Detroit River.
3. On April 10, 1970, Wyandotte Chemicals placed into operation a treatment system for their mercury wastes which reduced the discharge of mercury to about two lbs/day. On April 26, 1970, Wyandotte Chemicals diverted all treated mercury wastes to a deepwell on Grosse Ile from which brine is obtained for their chlor-alkali process.
4. Sample analysis results indicate the following levels of mercury contamination in the areas specified:

AREA	MERCURY LEVELS IN SEDIMENT (mg/kg dry weight)
Lower St. Clair River-Lake St. Clair	Mercury in all samples less than the lowest reliable, detectable level.
Upper Detroit River (Headwaters to Grassy Island)	Mercury levels range from less than the detectable level near

4. (cont.)

AREA	**MERCURY LEVELS IN SEDIMENT (mg/kg dry weight)**
	the head to 0.9-1.4 in backwater areas along the U.S. shore above the Rouge River and as high as 4.4 in backwater areas below the Rouge.
Lower Detroit River Trenton Channel	In a narrow strip of about 20 to 100 feet along the U.S. shoreline, levels range from 86.0 to 5.4 within a mile below the Wyandotte Chem. outfall and then vary from 27.0 to the detectable limit downstream to Lake Erie depending on the settling characteristics of the specific point.
Main River	Levels in all but two samples in the main lower river were below the detectable level. Of the two positive samples, the one near the eastern shore of South Fighting Island contains 1.2 mg/kg and the one near the Canadian shore at Lake Erie contains 0.6 mg/kg.
Northern Grosse Ile	Levels in samples along the northern part of Grosse Ile, the area of Wyandotte Chemicals waste beds were all below the detectable level.

4. (cont.)

AREA	MERCURY LEVELS IN SEDIMENT (mg/kg dry weight)
Western Lake Erie Michigan Waters	Levels near the Detroit Light varied from 1.0 to 2.1 along the Michigan shore all below the detectable limit except near LaPlaisance Bay where one sample contained 0.8 mg/kg.
Ohio Waters	Four points near West Sister Island have values ranging from 1.6 to 2.1 mg/kg. Other areas nearer to shore had values less than the detectable limit.
Canadian Waters	Levels of 1.3 to 2.7 were recorded at three points extending eastward about 15 miles from the Detroit Light and about 5 miles from the Ontario shore. Points extending to Pelee Island showed no detectable mercury.

5. The mercury in the waters of the study area were all below the lowest detectable level except for one sample collected just below the Wyandotte Chem. outfall, W23, and this level was only 0.03 mg/1.

6. Further surveys and analyses will be required to determine the depth of the mercury contamination in the sediment, to refine and verify the levels of contamination in and around areas where it has been found, to monitor the levels over time as the discharges are eliminated, and to determine the forms of mercury present.

MERCURY SURVEY IN THE DETROIT RIVER AREA

Investigation of Wyondotte Chemicals Corp.

Following the discovery of mercury in fishes caught in Canadian waters, the State of Michigan reviewed the mercury-using industries in the State and found that the Wyandotte Chemicals Corporation of Wyandotte, Michigan was a major user of mercury. The Michigan Water Resources Commission, after consultations with the Wyandotte Chemicals Corporation gave the following information to the Lake Huron Basin Office of the Federal Water Quality Administration.

The mercury cell operation at Wyandotte consumes an average of 80 lbs/day of mercury of which approximately 10-20 lbs/day is discharged to the river. Wyandotte Chemicals bases their estimate of 10-20 lbs/day on composite samples collected and composited for three 8-hour periods each day. The pounds per day figures given for FWQA sampling generally indicate higher values. However, FWQA conducted grab sampling operations at the point of discharge to the river which are generally not directly comparable with composite figures when there is variation in concentration of waste throughout the day. It was also discovered from consultations with Wyandotte Chemicals that concentration varies throughout the cross section of the discharge flume. The Lake Huron Basin Office began sampling the effluent from Wyandotte Chemical on March 27, 1970. The results are given in the following table:

Effluent Samples By FWQA From Wyandotte Chemicals Corp.
(Outfall Code W23)

Date	Day	Mercury Content (mg/l as Hg) AM	Mercury Content (mg/l as Hg) PM	Approx. Loading (lbs/day)
March 27	F	.10		11
30	M		.32	36
31	T	.66		74
April 3	F	.33	.23	31
6	M	.24	.11	18
7	T	.14	.40	30
8	W	.11	.11	12
9	T		.32	36
10	F	.12	<.01 (effluent from mercury cells diverted to temporary treatment pond at 1230)	

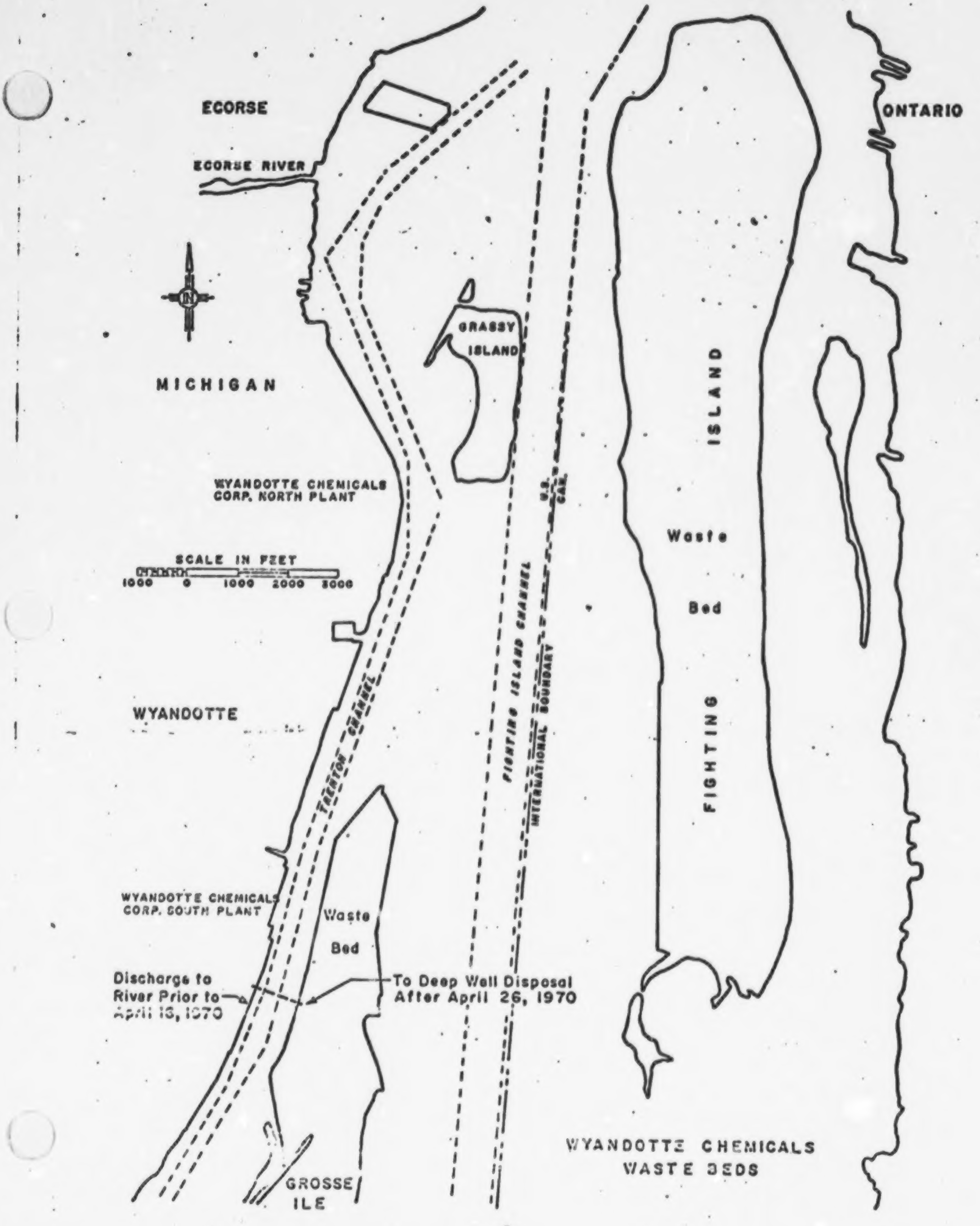
Date	Day	mg/l as Hg		Approx. lbs/day
		AM	PM	
April 15	W	.006	.026	1.8
" 16	T	.027	<.005 (plant shut down by State of Michigan temporary injunction at 1620)	1.4
" 17	F		.023	2.6
" 18	S	<.005		0
" 19	S	<.005		0
" 20	M	<.005	<.005	0
" 21	T	.008	.005	.7
" 22	W	<.005		0
" 23	T	<.005	<.005	0
" 24*	F	.015	.018	1.8
" 25	S	.010	.006	0.9
" 26**	S	<.005	.005	T
" 27	M	.007	<.005	T
" 28	T	.005	<.005	T
" 29	W	<.005	<.005	0
" 30	T	<.005	<.005	0

* Losses from W-23 on Friday, April 24 and other minor losses since are verified by Wyandotte Chemicals through Michigan Water Resources Commission. No explanation can be found. Wyandotte Chemicals is conducting an intensive cleanup of all piping, valving building areas, etc., around the mercury cell operation to prevent further losses.

We can probably expect small losses from accumulations of 30 years of use. Storm runoff from roof and grounds may also contribute.

** Operation of mercury cell process was resumed. State of Michigan approved a plan of operation in which mercury waste is treated in settling ponds, then discharged to brine caverns on Grosse Ile. This is a closed system; brine is pumped from the cavern to Wyandotte Chemicals for use in their processes.

Figure 1a


ECORSE
ECORSE RIVER
ONTARIO
N
GRASSY ISLAND
MICHIGAN
WYANDOTTE CHEMICALS CORP. NORTH PLANT
SCALE IN FEET
1000 0 1000 2000 3000
WYANDOTTE
TRENTON CHANNEL
FIGHTING ISLAND CHANNEL
INTERNATIONAL BOUNDARY
U.S.
CAN.
FIGHTING ISLAND
Waste Bed
WYANDOTTE CHEMICALS CORP. SOUTH PLANT
Waste Bed
Discharge to River Prior to April 13, 1970
To Deep Well Disposal After April 26, 1970
GROSSE ILE

WYANDOTTE CHEMICALS WASTE BEDS

April 3: Wyandotte Chemicals was called into the Water Resources Commission office and proposed a system of treatment which was tentatively approved by the State agency. Construction began immediately. They blocked off the effluent pipes at the mercury cell and installed temporarily above-ground piping system from that point to a large concrete-lined containment area which had formerly been used for storage of limestone. An earth dike was used to form a reaction pond area at the south end of the pond, the remainder of the pond being used as a settling area. Weak cell liquor was introduced to the pipeline to keep the pH above normal. An estimated 600 gallons/minute of mercuric chloride waste from the mercury cell was then discharged through the pipeline to a baffled timber mixing box before discharge to the reaction pond. NaHS and spent sulfuric acid were added at the mixing box before discharge to the reaction pond. After about 6 hours retention in the reaction pond, the effluent discharges through another mixing box to the settling pond at which point cell liquor is added to bring the pH to neutral. In the settling pond, mercuric sulfide is precipitated which removes approximately 80-90% of mercury. The discharge from this pond was then discharged to a larger sewer which contained other wastes from the plant and then discharged to the Detroit River.

April 10: This system was placed in operation. All waste from the mercury cell was diverted into the pond system. There was no detectable discharge to the river as indicated in the following table.

Date	Day	Mg/1 as Hg AM	Mg/1 as Hg PM	Approx. lbs/day
April 13	M		< .005	0
" 14	T	< .005	< .005 (pond filled, treated effluent discharging to sewer at 1930)	0

April 15-16: Waste discharged to the river through the temporary treatment system contained approximately 2 lbs. of mercury/day.

INSPECTION OF EMERGENCY FACILITIES AT WYANDOTTE CHEMICALS PLANT

April 16, 1970

L. B. O'Leary, Director of the Lake Huron Basin Office, Federal Water Quality Administration and W. E. Denniston, District Engineer, Michigan Water Resources Commission toured the mercury cell and waste treatment operations of Wyandotte Chemicals Corporation accompanied by Mr. J. Hunter, Waste Control Chemist of Wyandotte Chemicals.

The waste treatment operation for the effluent containing mercury is shown on the accompanying sketches.

All waste from the mercury cell operation including floor drains is intercepted before it reaches the river and pumped through temporary above-ground piping systems to the waste pond.

The waste pond is a concrete-lined depression formerly used for limestone storage. Earth dikes divide the pond into two areas; the smaller portion in the south end of the pond is used as a reaction area, the remainder is used as a settling pond.

The pond took longer than anticipated to fill indicating leakage. Seams in the concrete were filled with asphalt compound and an area along the west wall was covered with a clay blanket. These measures apparently stopped the leakage problem. The company representative informed us that under drains from the pond connect to the discharge flume at W23 and the leaks were in the settling pond area so that even if leakage occurred it would be treated effluent and would be measured at the same point as the effluent from the pond.

Composite samples collected and analyzed by Wyandotte Chemicals on three shifts at a point approximately 20 feet upstream in the waste flume from the point sampled by FWQA at the point of discharge to the river are as follows. Comparison with FWQA sampling for the same day is shown.

		mg/l as Hg			Approx. lbs/day
April 15	Wyandotte Chem. Composite	.027	.014	.012	1.8
			AM	PM	
	FWQA Grab Samples		.006	.027	1.8

Figure 1

LAKE HURON BASIN OFFICE

SKETCH OF
WYANDOTTE CHEMICALS
TEMPORARY MERCURY TREATMENT
APRIL 16, 1970
No Scale

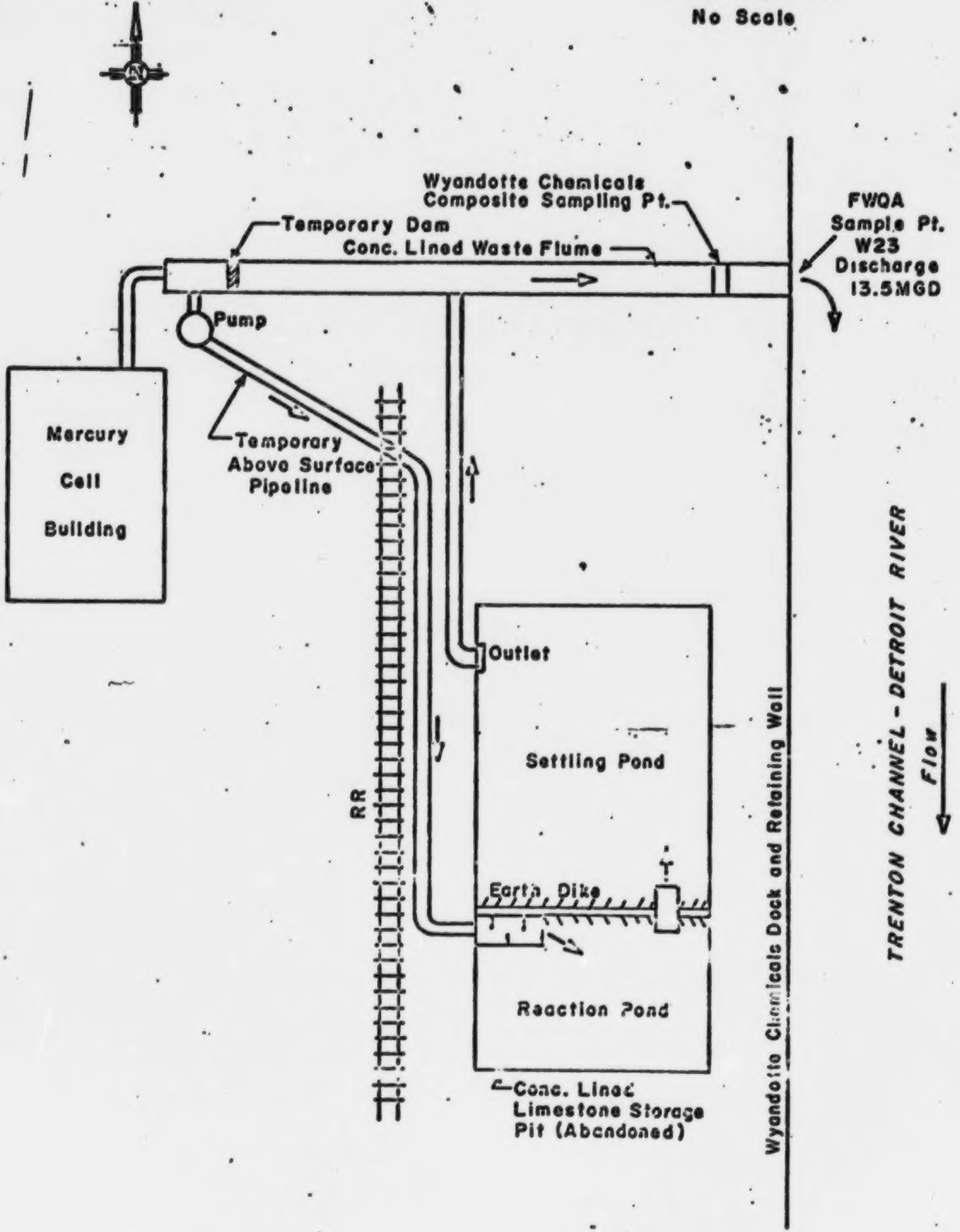

N
Wyandotte Chemicals Composite Sampling Pt.
Temporary Dam
Conc. Lined Waste Flume
FWQA Sample Pt. W23
Discharge 13.5MGD
Pump
Mercury Cell Building
Temporary Above Surface Pipeline
RR
Outlet
Settling Pond
Earth Dike
Reaction Pond
Conc. Lined Limestone Storage Pit (Abandoned)
Wyandotte Chemicals Dock and Retaining Wall
TRENTON CHANNEL - DETROIT RIVER
Flow

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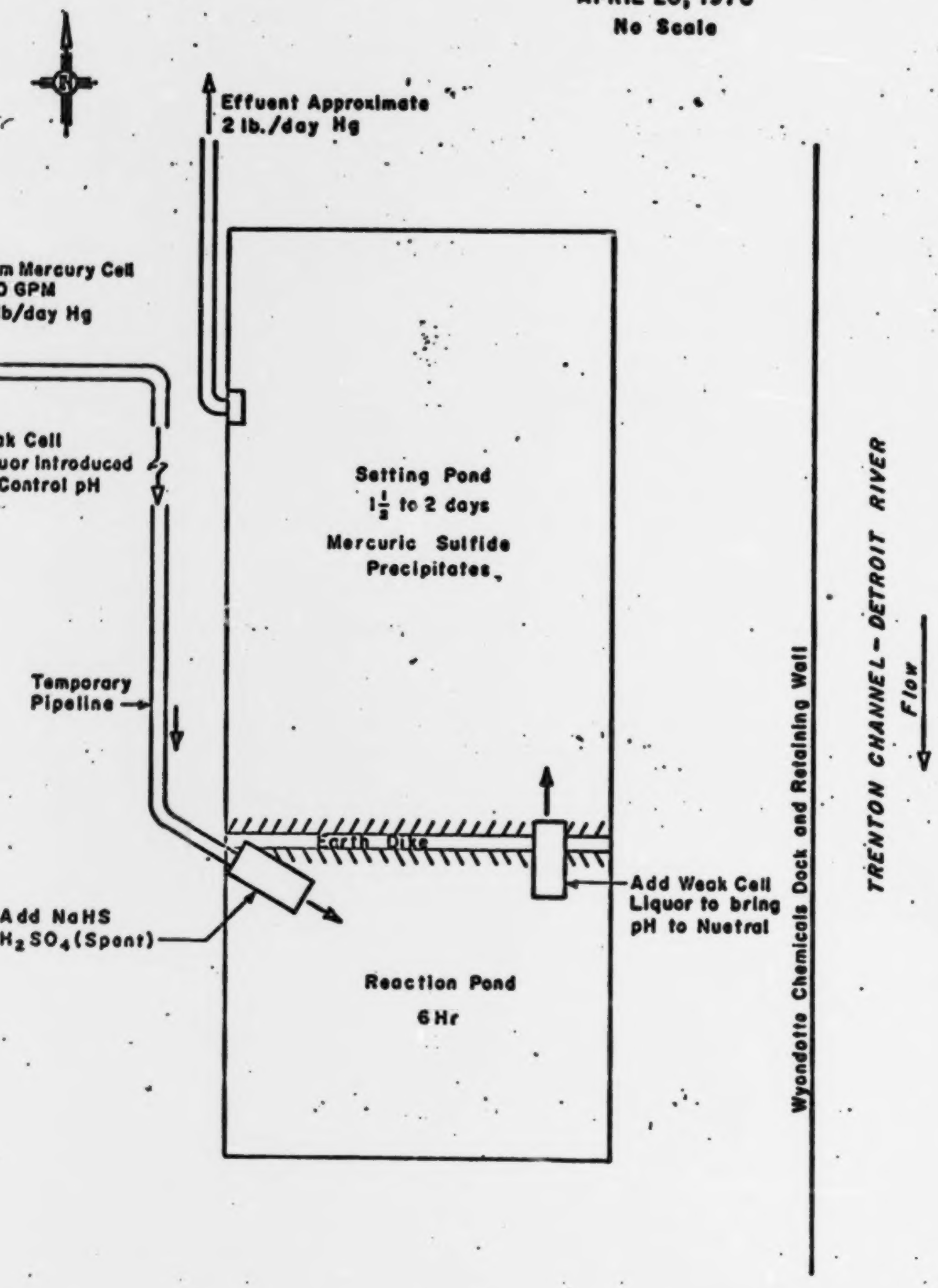
Fig 2 **Figure 2**

LAKE HURON BASIN OFFICE

SKETCH OF
WYANDOTTE CHEMICALS
TEMPORARY MERCURY TREATMENT

APRIL 20, 1970

No Scale



N
Effuent Approximate 2 lb./day Hg
From Mercury Cell 600 GPM 20lb/day Hg
Weak Cell Liquor Introduced To Control pH
Setting Pond
$1\frac{1}{2}$ to 2 days
Mercuric Sulfide Precipitates
Temporary Pipeline
Earth Dike
Add NaHS H_2SO_4(Spent)
Add Weak Cell Liquor to bring pH to Nuetral
Reaction Pond
6 Hr
Wyandotte Chemicals Dock and Retaining Wall
TRENTON CHANNEL – DETROIT RIVER
Flow

36

Water and Sediment Survey Results

The Federal Water Quality Administration (FWQA) Lake Huron Basin Office (LHBO) initiated a water and sediment sampling and analysis program for mercury in the St. Clair River to Lake Erie system immediately after the Canadian Government announced the fishing ban in Lake St. Clair on March 24, 1970. After establishing liaison with concerned Federal and State agencies, the staff selected an analytical method for mercury described in E. B. Sandell's "Colorimetric Metal Analysis." This method utilizes dithizone in chloroform for colorimetric determination.

Sample collections were made by LHBO assisted by Michigan Water Resources Commission (MWRC) personnel aboard the two 21-foot LHBO outboard patrol boats; and, for deepwater areas of Lake Erie, the LHBO 42-foot laboratory boat - BLUE WATER. All samples were returned to the LHBO laboratory on the day of collection. Most samples have been split with the MWRC for duplicate analysis by State laboratories.

Water samples were collected in ½ gallon glass bottles using a surface grab-sampler. Sediment samples are obtained by use of either a Petersen dredge or a drag line sampler. These devices penetrate the bottom of a depth of about ½ foot. Physical properties such as odor, color, general composition of the bottom materials were recorded.

Lower St. Clair River and Lake St. Clair:

Sampling of the St. Clair River commenced on March 26 with collection of four sediment and six water samples at ranges near Marine City and Algonac. Eight additional sediment samples were collected from the mouth to Marine City on April 30. Three days were devoted to sampling Lake St. Clair - April 15, 21, and 22. The effort was devoted to the U.S. waters near shore, Anchor Bay, and the discharge area of the St. Clair River.

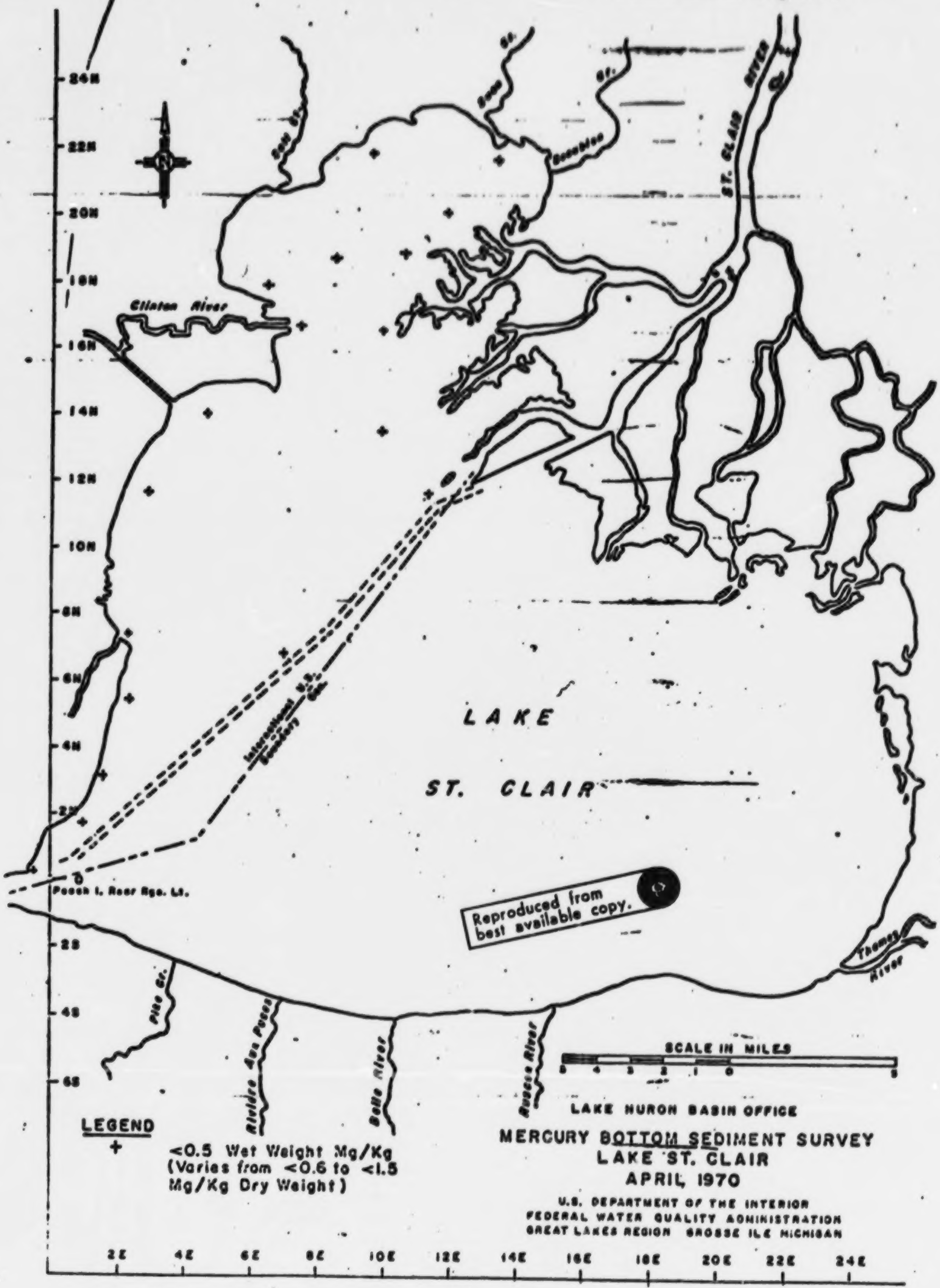
The results of the chemical analysis for mercury on these samples are tabulated on Table 1&2and the sampling points and indication of the mercury levels in sediments are shown on Figure 3.

The levels of mercury in the sediments are below the reliable, detectable limit of 0.5 mg/kg wet weight, although traces of mercury were indicated in most of the Lake St. Clair samples.

28

53<

Figure 3


24N
22N
20N
18N
16N
14N
12N
10N
8N
6N
4N
2N
0
2S
4S
6S
2E
4E
6E
8E
10E
12E
14E
16E
18E
20E
22E
24E
N
Clinton River
Salt Cr.
Swan Cr.
Marine Cr.
Bouvier Cr.
St. Clair River
LAKE
ST. CLAIR
International U.S. Boundary
Peach I. Rear Rge. Lt.
Thames River
Pike Cr.
Rivière Aux Puces
Belle River
Ruscom River
SCALE IN MILES
8 4 3 2 1 0 8

LEGEND

+ <0.5 Wet Weight Mg/Kg (Varies from <0.6 to <1.5 Mg/Kg Dry Weight)

LAKE HURON BASIN OFFICE

MERCURY BOTTOM SEDIMENT SURVEY
LAKE ST. CLAIR
APRIL 1970

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE MICHIGAN

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Table 1

MERCURY SURVEY

Sample Analysis Results

St. Clair River

Sample Collection Date	Location		Mercury Content		
			Sediment (mg/kg)		Water
	River Mile	Ft. from U.S. Shore	Wet Basis	Dry Basis	(mg/l)
1970					
3/26	10.4	20	< 0.5		< 0.01
"	10.6	1850			< 0.01
"	10.6	4120	< 0.5		< 0.01
"	17.5	20	< 0.5		< 0.01
"	17.5	1500			< 0.01
"	17.5	2700	< 0.5		< 0.01
4/30	35.4	100	< 0.5		
"	33.5	100	< 0.5		
"	31.5	100	< 0.5		
"	29.5	100	< 0.5		
"	27.5	100	< 0.5		
"	23.5	100	< 0.5		
"	21.5	100	< 0.5		
"	19.5	100	< 0.5		

Table 2

MERCURY SURVEY

Sample Analysis Results

Lake St. Clair

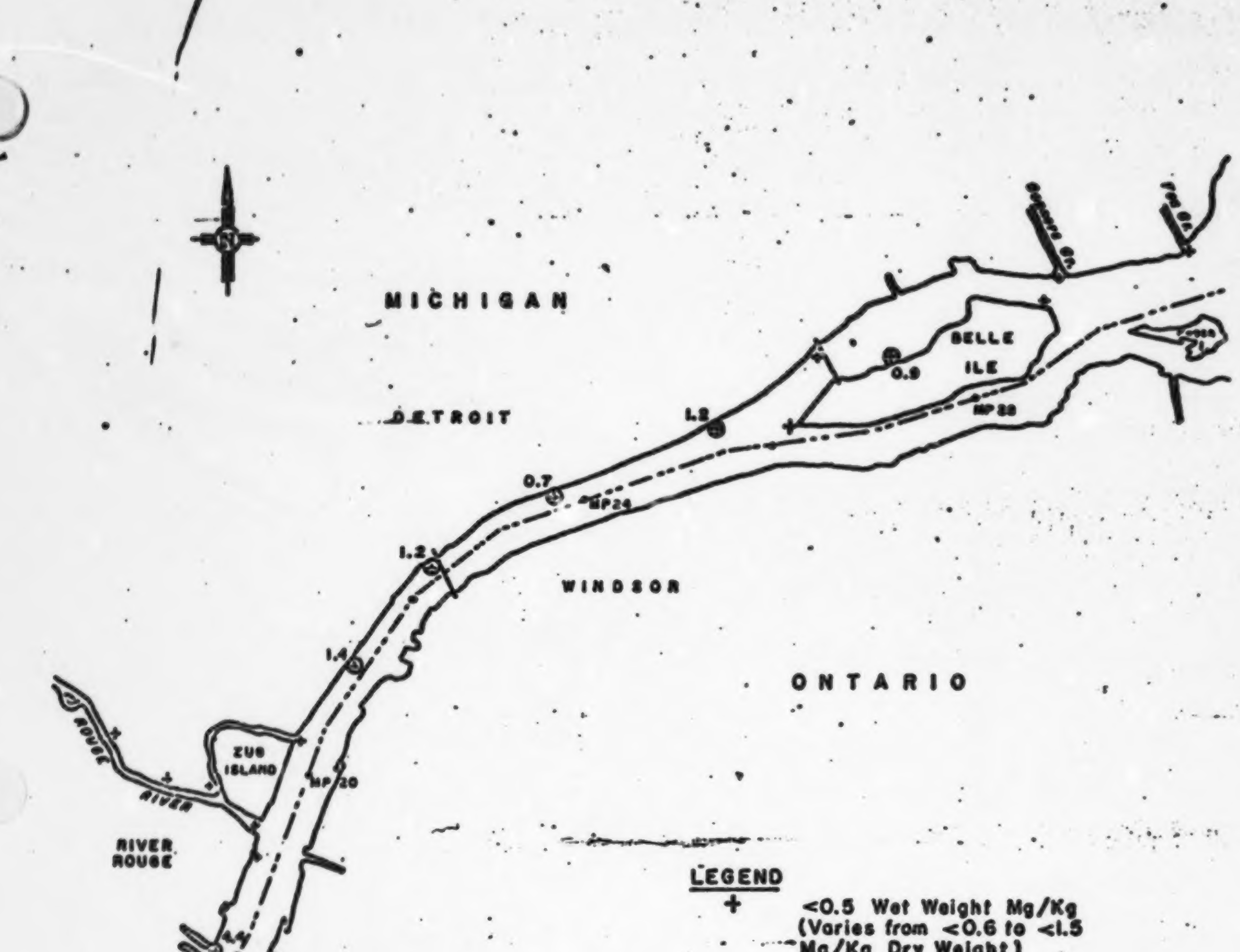
Sample Collection Date	Location Grid Coordinates		Mercury Content Sediment (mg/kg) Wet Basis	Mercury Content Sediment (mg/kg) Dry Basis	Water (mg/1)
1970					
4/15	18.8N	10.6E	< 0.5		
"	3.8N	4.3E			< 0.005
"	13.5N	9.9E	< 0.5		
"	16.5N	10.0E	< 0.5		
"	16.6N	7.6E	< 0.5		
"	18.7N	8.6E	< 0.5		
"	20.0N	11.9E	< 0.5		
4/21	0.4N	0.4W	< 0.5		
"	1.8N	1.1E	< 0.5		
"	3.2N	1.7E	< 0.5		
"	5.5N	2.5E	< 0.5		
"	7.5N	2.3E	< 0.5		
4/22	6.8N	7.1E	< 0.5		
"	11.2N	11.2E	< 0.5		
"	11.6N	2.9E	< 0.5		
"	13.9N	4.8E	< 0.5		
"	17.8N	6.6E	< 0.5		
"	21.7N	9.6E	< 0.5		
"	21.5N	13.4E	< 0.5		

Upper Detroit River:
(Lake St. Clair to Grassy Island)

Sampling of the upper Detroit River and lower Rouge River began on March 26 and continued on for five days to April 24. Sixteen sediment and 6 water samples were obtained as indicated on Tables 3 & 4 and and on Figure 4. The mercury was detected in sediments along the U.S. shoreline in boat ramps and other backwater areas. Values ranged from below the detectable level near the headwaters to 4.4 mg/kg below the Rouge. Levels in sediments around Grassy Island and upper Fighting Island were all below the detectable limit.

57<

Figure 4



N
MICHIGAN
DETROIT
BELLE ILE
0.9
1.2
0.7
MP24
1.2
WINDSOR
1.4
ONTARIO
ZUG ISLAND
MP 20
ROUGE RIVER
RIVER ROUGE
ECORSE
1.7
2.0
MP16
FIGHTING ISLAND
1.2
L.S. U.S. CHAN.
MP12
LEGEND
+ <0.5 Wet Weight Mg/Kg (Varies from <0.6 to <1.5 Mg/Kg Dry Weight)
⊕5.0 Dry Weight Mg/Kg
•MP30 Mile Points
SCALE IN MILES
0
1
2
3

LAKE HURON BASIN OFFICE

MERCURY BOTTOM SEDIMENT SURVEY
UPPER DETROIT RIVER
APRIL 1970

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE MICHIGAN

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Table 3

MERCURY SURVEY

Sample Analysis Results

Upper Detroit River
(upstream from the Rouge River)

Sample Collection Date	Location		Mercury Content		
			Sediment (mg/kg)		Water
	River Mile	Feet from U.S. Shore	Wet Basis	Dry Basis	(mg/1)
1970					
3/26	26.8	700	< 0.5		< 0.01
3/30	30.8	500			< 0.01
"	30.8	1000			< 0.01
"	30.7	500			< 0.01
"	30.7	980			< 0.01
4/14	29.3	1600	< 0.5		
4/23	30.8	0	< 0.5		
"	29.4	0	< 0.5		
"	27.4	3300	0.6	0.9	
"	26.2	2300	< 0.5		
"	25.7	0	0.9	1.2	
"	23.8	100	0.5	0.7	
"	22.3	0	0.6	1.2	
"	21.1	0	0.7	1.4	

Table 4

MERCURY SURVEY

Sample Analysis Results

Rouge River

Sample Collection Date	River Mile	Mercury Content Sediment (mg/kg) Wet Basis	Mercury Content Sediment (mg/kg) Dry Basis	Mercury Content Water (mg/l)
1970				
3/26	1.1	< 1.0		< 0.01
4/23	.3 Old Channel	< 0.5		
"	1.5 Old Channel	< 0.5		
4/24	1.8	< 0.5		
"	3.1	< 0.5		
"	.1	< 0.5		

Lower Detroit River:
(Grassy Island to mouth)

In the portion of the Detroit River from Grassy Island to the mouth at Lake Erie, 78 sediment and 23 water samples were collected between March 26 and April 16 as shown in Tables 5 and 6 and Fig.5. The highest levels of mercury occurred in the bottom muds of the Trenton Channel below the Wyandotte Chemicals Corp. South Works in a narrow strip of from 20 to 100 feet along the western shore. Levels along the east shore of the channel near Grosse Ile are less than the detectable limit of 0.5 mg/kg. Mercury in the sediments indicates that the Wyandotte Chemicals mercury discharge hugs the western shore of the Trenton Channel depositing mercury in the bottom muds along shore. No mercury deposits were found around Wyandotte Chemicals waste beds located on the northern tip of Grosse Ile.

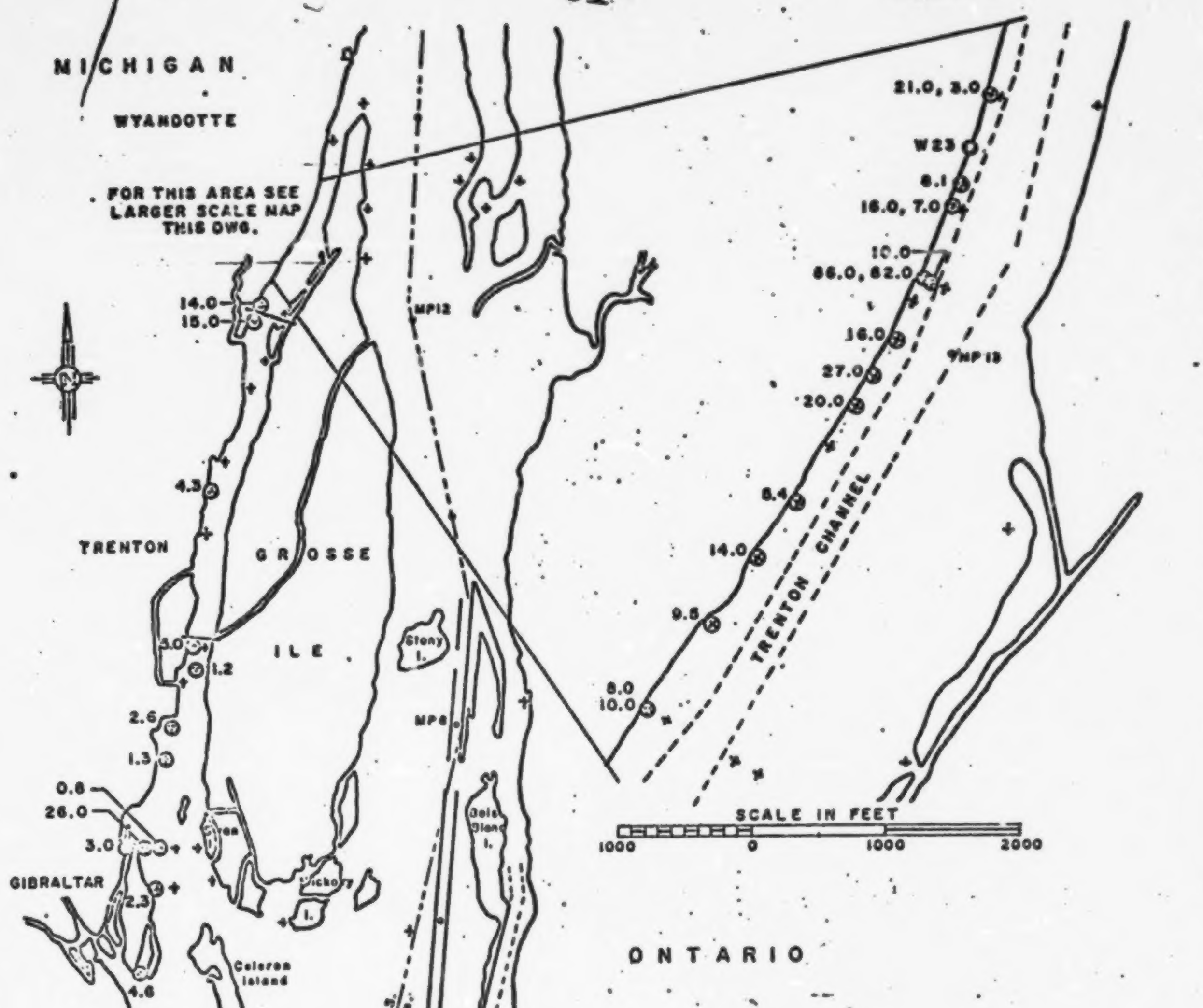
Mercury contamination in sediments was found along shore as far as Lake Erie . In addition to high values near Wyandotte Chemicals, one sample with 26.0 mg/kg dry weight was found at the northern tip of Horse Island at mile point 6.7.

Of the four samples collected at the southern end of Fighting Island, one contained 1.2 mg/l mercury and the others contained trace amounts, but all below the detectable limit. Wyandotte Chemicals waste lagoons are located on Fighting Island.

The only mercury detected in four samples in Canadian sediments was near the shore at mile point 3.9.

As indicated in the tables, the levels of mercury in all water samples but one were below the detectable limit of 0.01 mg/l. One sample collected 300 feet downstream from Wyandotte Chemicals outfall W-23 contained 0.03 mg/l. The effluent is diluted by Detroit River water so that mercury is not detectable further downstream from the discharge point.

Figure 5


MICHIGAN
WYANDOTTE
FOR THIS AREA SEE LARGER SCALE MAP THIS DWG.
14.0
15.0
4.3
TRENTON
GROSSE ILE
3.0
1.2
2.6
1.3
0.8
26.0
3.0
GIBRALTAR
2.3
4.6
Celeron Island
Stony I.
Bois Blanc I.
Hickory I.
MP12
MP8
MP4
U.S. Chan.
International Boundary
11.0
0.6
Huron River
Detroit River Lt.
LAKE ERIE
ONTARIO
21.0, 3.0
W23
8.1
16.0, 7.0
10.0
86.0, 82.0
16.0
27.0
20.0
MP13
8.4
14.0
9.5
8.0
10.0
TRENTON CHANNEL
SCALE IN FEET
1000
0
1000
2000
LEGEND
+ <0.5 Wet Weight Mg/Kg (Varies from <0.6 to <1.5 Mg/Kg Dry Weight)
⊕5.0 Dry Weight Mg/Kg
•MP20 Mile Points
SCALE IN MILES
1
0
1
2
3

LAKE HURON BASIN OFFICE

MERCURY BOTTOM SEDIMENT SURVEY
LOWER DETROIT RIVER
APRIL 1970

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE MICHIGAN

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Table 5

62<

MERCURY SURVEY

Sample analysis Results

Lower Detroit River
(below the mouth of the Rouge River
excluding the Trenton Channel)

Sample Collection Date	Location		Mercury Content		
	River Mile	Ft. from U.S. Shore	Sediment (mg/kg) Wet Basin	Sediment (mg/kg) Dry Basis	Water (mg/l)
1970					
3/27	13.5	9400	< 1.0		< 0.01
"	13.3	8850	< 0.5		
"	8.4	17,700	< 0.5		
"	3.9	15,000	< 0.5		< 0.01
"	3.9	19,000	0.5	0.6	< 0.01
3/30	3.9	15,000			< 0.01
"	3.9	19,000			< 0.01
4/6	5.9	13,500	< 1.0		
4/8	14.2	1400	< 0.5		
"	13.7	2100	< 0.5		
"	13.3	2400	< 0.5		
"	12.7	3200	< 0.5		
"	15.3	1500	< 0.5		
"	16.0	2300	< 0.5		
4/14	14.6	1300	1.1	4.4	
"	16.0	5500	< 0.5		
"	16.3	500	0.7	2.0	
"	16.4	0	0.5	1.7	
"	16.5	2900	< 0.5		
"	16.7	1000	< 0.5		
"	18.1	0	< 0.5		
"	19.0	0	< 0.5		
4/16	16.3	9950	< 0.5		
"	14.8	8200	0.7	1.2	
"	13.5	7200	< 0.5		
"	13.6	7700	< 0.5		
"	15.3	4300	< 0.5		
"	17.1	2500	< 0.5		
"	16.0	3700	< 0.5		
"	15.4	1000	< 0.5		

63<

Table 6

MERCURY SURVEY

Sample Analysis Results

Detroit River-Trenton Channel Area

Sample Collection Date	Location		Mercury Content		
			Sediment (mg/kg)		
	River Mile	Feet from U.S. Shore	Wet Basis	Dry Basis	Water (mg/l)
1970					
3/26	8.7	80	<1.0		< 0.01
3/27	13.1	20	28.0	86.0	
"	13.4	20	13.0	21.0	
"	13.2	20	10.0	16.0	
"	12.4	20	4.0	8.0	
"	3.9	2500	4.9	11.0	< 0.01
"	3.9	6500	< 0.5		< 0.01
3/30	3.9	2500			< 0.01
"	3.9	6500			< 0.01
3/31	13.2	20			< 0.01
"	13.1	20			< 0.01
"	13.3	20			0.03
4/1	13.4	20	2.0	3.0	
"	13.4	100	< 2.0		
"	13.2	20	5.0	7.0	
"	13.2	100	< 2.0		
"	13.1	20	25.0	82.0	
"	13.1	100	6.0	10.0	
"	13.1	200	< 2.0		
"	12.4	20	4.0	10.0	
"	12.4	200	< 2.0		
"	12.4	800	< 2.0		
"	12.4	1000	< 2.0		
"	13.9	0	< 2.0		
"	12.0	0	6.0	14.0	
4/3	13.2	20			<0.01
"	13.1	20			<0.01
"	12.4	20			<0.01
"	13.3	20			<0.01
"	12.8	20			<0.01
"	12.0	20			<0.01
"	11.3	50			<0.01
"	10.5	50			<0.01
"	9.8	50			<0.01
"	8.7	80			<0.01

39

Table 6

MERCURY SURVEY

Sample Analysis Results

Detroit River-Trenton Channel Area (cont.)

Sample Collection Date	Location		Mercury Content		
			Sediment (mg/kg)		Water
	River Mile	Feet from U.S. Shore	Wet Basis	Dry Basis	(mg/l)
1970					
4/6	8.7	80	1.9	5.0	
"	8.7	1240	< 1.0		
"	10.2	0	2.8	4.3	
"	7.9	300	1.7	2.6	
"	5.4	600	2.2	4.6	
"	4.7	6200	< 1.0		
"	5.8	7200	< 1.0		
"	12.0	20	7.1	15.0	
4/7	7.6	100	1.0	1.3	
"	6.7	150	11.0	26.0	
"	6.3	1200	< 1.0		
"	6.3	3400	< 1.0		
4/8	11.6	1150	< 0.5		
"	12.0	1850	< 0.5		
"	12.5	1850	< 0.5		
"	12.8	1500	< 0.5		
"	13.4	850	< 0.5		
4/16	8.6	600	0.9	1.2	
4/17	6.7	100	0.9	3.0	
"	6.7	1000	0.6	0.8	
"	6.7	2000	< 0.5		
"	6.7	3000	< 0.5		
"	6.3	150	1.5	2.3	
4/24	8.3	0	< 0.5		
4/26	13.0	20	< 0.5		
"	13.0	20	4.9	16.0	
"	12.9	20	12.0	27.0	
"	12.8	20	9.7	20.0	
"	12.7	20	2.4	5.4	
"	12.6	20	5.6	14.0	
"	12.5	20	4.3	9.5	
"	13.2	20	5.7	8.1	

Western Basin of Lake Erie - Including the Raisin and Maumee Rivers:

The sampling of Lake Erie began on April 6, 1970 with bottom sediments collected at two (2) stations near the mouth of the Huron River (Figure 6). From April 6 to April 27, 44 bottom sediment stations were sampled. Samples were collected in western Lake Erie west of Pelee Island with the majority of samples collected near the mouths of Michigan tributaries. Based on the reliable, detectable limit of 0.5 mg/kg wet weight, mercury was found at 16 of the 44 stations, although traces were found at most of the other stations. (See Table 7.)

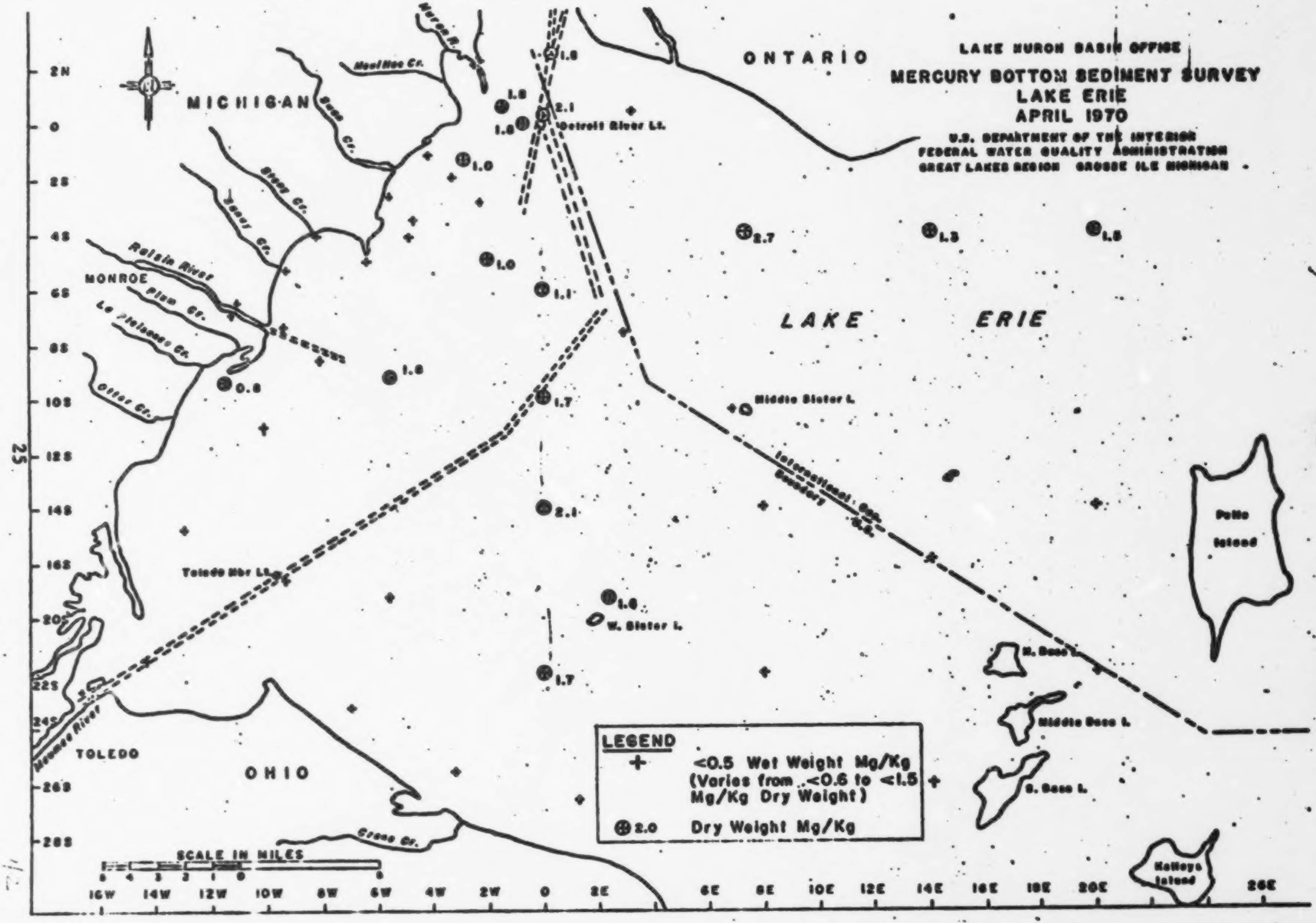
The Raisin River was sampled on 2 different dates at 3 stations. Traces of mercury were found; however, all results were below the reliable, detectable limit, Table 8 .

The Maumee River was sampled on April 17 at 6 stations, and traces of mercury found at most stations; however, all results were below the reliable, detectable limit, Table 9 .

The 16 stations, where mercury was found, are located in the deepwater areas of the western basin of Lake Erie from the mouth of the Detroit River southward and eastward. Since shoreline and minor tributary do not show appreciable amounts of mercury, the Detroit River appears to be the principal source with mercury being deposited in the deeper quiescent parts of the lake.

66<

Figure 6



LAKE HURON BASIN OFFICE

MERCURY BOTTOM SEDIMENT SURVEY
LAKE ERIE
APRIL 1970

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER QUALITY ADMINISTRATION
GREAT LAKES REGION GROSSE ILE MICHIGAN

ONTARIO
MICHIGAN
OHIO
LAKE ERIE
TOLEDO
MONROE
Huron R.
Muddy Cr.
Swan Cr.
Stony Cr.
Sandy Cr.
Raisin River
Plum Cr.
La Plaisance Cr.
Otter Cr.
Maumee River
Crane Cr.
Detroit River Lt.
Toledo Hbr Lt.
Middle Sister I.
W. Sister I.
International Boundary
Pelee Island
N. Bass I.
Middle Bass I.
S. Bass I.
Kelleys Island
1.8
1.8
2.1
1.8
1.0
2.7
1.3
1.5
1.0
1.1
1.8
0.8
1.7
2.1
1.6
1.7
2N
0
2S
4S
6S
8S
10S
12S
14S
16S
20S
22S
24S
26S
28S
16W
14W
12W
10W
8W
6W
4W
2W
0
2E
6E
8E
10E
12E
14E
16E
18E
20E
26E
SCALE IN MILES
8 4 3 2 1 0 6

LEGEND
+ <0.5 Wet Weight Mg/Kg (Varies from <0.6 to <1.5 Mg/Kg Dry Weight)
⊕ 2.0 Dry Weight Mg/Kg

12

67

Table 7

MERCURY SURVEY

Sample Analysis Results

Lake Erie

Sample Collection Date 1970	Location Grid Coordinates		Mercury Content Sediment (mg/kg) Wet Basis	Dry Basis	Water (mg/l)
4/6	2.2N	2.6W	< 1.0		
"	2.0N	2.4W	< 1.0		
4/7	0.7N	1.3W	1.0	1.8	
"	0.0N	0.6W	1.0	1.8	
"	1.3S	4.2W	< 0.5		
"	2.0S	3.2W	< 0.5		
"	2.9S	2.2W	< 1.0		
"	3.7S	4.8W	< 0.5		
4/10	2.8S	5.8W	< 0.5		
"	4.3S	8.3W	< 0.5		
"	5.0S	6.4W	< 0.5		
"	5.4S	9.5W	< 0.5		
"	9.6S	11.6W	0.6	0.8	
4/14	17.4S	0.4E	0.5	1.6	
"	0.5N	3.2E	< 0.5		
"	5.1S	2.0W	0.5	1.0	
"	8.7S	3.8E	< 0.5		
"	9.4S	5.7W	0.8	1.8	
"	10.7S	6.7E	< 0.5		
"	18.2S	12.0W	< 0.5		
"	17.4S	5.8W	< 0.5		
4/15	11.2S	10.3W	< 0.5		
"	1.3S	2.9W	0.8	1.0	
"	4.3S	4.9W	< 0.5		
"	8.6S	8.1W	< 0.5		
"	14.8S	13.1W	< 0.5		
"	21.3S	7.1W	< 0.5		
"	23.6S	3.5W	< 0.5		
"	24.8S	1.2E	< 0.5		
4/25	6.0S	0.0	0.7	1.1	
"	10.0S	0.0	0.6	1.7	
"	14.0S	0.0	0.6	2.1	
"	14.0S	8.0E	< 0.5		
"	20.0S	0.0	0.5	1.7	
"	20.0S	8.0E	< 0.5		
"	24.0S	14.0E	< 0.5		
4/27	2.4N	0.4E	1.0	1.8	
"	0.3N	0.0E	1.0	2.1	
"	4.0S	8.0E	0.9	2.7	
"	4.0S	14.0E	0.5	1.3	
"	4.0S	20.0E	0.5	1.5	
"	14.0S	20.0E	< 0.5		
"	20.0S	20.0E	< 0.5		
"	16.0S	14.0E	< 0.5		

Table 8

MERCURY SURVEY

Sample Analysis Results

River Raisin

Sample Collection Date	Location		Mercury Content		
			Sediment (mg/kg)		Water
	Grid Coordinates	River Mile	Wet Basis	Dry Basis	(mg/l)
1970					
4/10	7.6S 9.8W	-0.5	< 0.5		
3/30	Consolidated Paper(S) W154	1.7	< 0.5		< .01
3/30	Mason Run at Ford Bridge W171	1.3-0.1	< 0.5		< .01

69<

Table 9

MERCURY SURVEY

Sample Analysis Results

Maumee River

Sample Collection Date	Location		Mercury Content		
	Grid Coordinates	River Mile	Sediment (mg/kg) Wet Basis	Dry Basis	Water (mg/l)
1970					
4/17		0.5	< 0.5		
"		0.0	< 0.5		
"		2.1	< 0.5		
"		5.1	< 0.5		
"		6.9	< 0.5		
"	19.6S 14.5W		< 0.5		

Mercury-Using Industries in Michigan

As a follow-up to the initial mercury survey in the St. Clair-Lake Erie system, the following information was obtained from the Michigan Water Resources Commission on industries using mercury in Michigan.

C & M Pharmical, Inc. 1519 E. 8 Mile Rd., Hazel Park, Mich. 48203	Firm states they have not purchased mercury in nine years.
Carrier-Stephens Co. 221 Depot St. Lansing, MI 48903	Buys 100 lbs/year. Repackage operations - sold to hospitals and used for gages.
Deterich Standard Corp. Ellison Instrument Div. Box 96, New Buffalo, MI 47119	Uses 50 lbs/year. Used to make permeability testing equipment.
G. A. Ingram Co. 4444 Woodward Ave., Detroit, MI 48201	80 lbs/year. Manufactures barometers for doctors and sells glass vials and 1-ounce capsules to doctors.
General Electric Co. Metallurgical Products Dept. Edmore, MI 48829	Discharge stopped by order of MWRC on 4/16/70.
General Motors Corp. AC Sparkplug Div. 1300 N. Dart Highway Flint, MI 48506	No mercury in manufacturing - only used in laboratory equipment; Central Foundry - only in lab. equipment.
H. O. Trerice 1749 Lafayette Blvd. Detroit, MI 48216	Manufactures pressure gages and equipment - uses about 1,000 lbs/year.
Harry W. Dietert Co. 9330 Roselawn Ave. Detroit, MI 48204	Uses about 50 lbs/year testing equipment and gages.
Madison Dental Supply Co. 15888 Wyoming Detroit, MI 48238	About 100 lbs/year - repackage and sell to dentists.
Detroit Edison Co. 2000 Second Ave. Detroit, Mi. 48202	Gages, etc.

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Dow Chemical Co. Midland, MI 48640	No consumption of mercury in Michigan plants. Used for gages, seals, etc. (Small mercury cell was in operation at Midland during 1950's -no longer operating. LHBO)
W. R. Grace & Co. Veratex Div. 18610 Fitzpatrick Detroit, MI 48228	Repackages and sells to dentists.
Wyandotte Chemical Co. Wyandotte, MI 48193	30,000 lbs/year (see report).
Upjohn Co. Kalamazoo, MI 49003	Use in laboratory gages

Fish Division of the Michigan Department of Natural Resources does not use mercury compounds for treating fish disease.

Every paper mill in Michigan was checked; two mills use mercury in surfacing compound about 2 lbs/year loss.

Repackaging, gage building, etc., are not thought to involve anything but very minor losses.

Spot checks by the FWQA of other waste discharges from Chrysler Corp., Monsanto, Pennwalt Chemicals, Wyandotte Chemicals (other than outfall W-23) and Consolidated Paper revealed no detectable mercury levels.

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APPENDIX A

Lake Huron Basin Office
Analytical Method for Mercury
in
Sediments and Water

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MERCURY METHOD
Bottom Sediment Samples

Reference: "Colorimetric Metal Analysis" by E. B. Sandell, pages 621-639, Interscience Publishers, Inc., New York, 1959, 3rd Edition.

Equipment: All glassware should be Hg cleaned with concentrated HNO_3. Distilled water used throughout the procedure should be double distilled.

1. Erlenmeyer flask (24/40) - 300 ml or equivalent.
2. 300 to 500 mm west condenser to fit above flasks (24/40).
3. Medium porosity sintered glass crucibles (Büchner Type).
4. Volumetric pipettes, flasks, etc. as required.
5. Additional equipment as in procedure for water samples.

Reagents:

1. Concentrated H_2SO_4.
2. 50% H_2O_2 (use 30% H_2O_2 if 50% not available).
3. 3% $KMnO_4$ solution (3 g. $KMnO_4$ diluted to 100 ml).
4. 20% hydroxylamine hydrochloride - 20 g. NH_2OH-HCl diluted to 100 ml (extract with dithizone solution (.001%) before using).
5. lM NaCl solution (58.44 g. NaCl diluted to 1 l.).
6. Additional reagents as in procedure for water samples.

Procedure:

1. Weigh 5 g. of the bottom sediment sample into a 300 ml erlenmeyer flask.
2. Add 10 ml of concentrated sulfuric acid. Attach West condenser and turn on cooling water.
3. Add 30% hydrogen peroxide dropwise through the condenser with swirling. Continue adding peroxide until the solution becomes colorless or pale yellow, or until two drops at once cause no further reaction.

Procedure: (cont'd)

4. Heat the flask gently for 20 minutes, continuing to add peroxide; boil for 2 minutes after the last addition.

5. Cool the flask (finally in a water bath) and add 15 ml of water. Mix and cool again.

6. Add the 3% potassium permanganate solution to a red coloration.

7. Rinse the condenser into the flask with water.

8. Remove the excess permanganate with 6 ml of the 20% hydroxylamine hydrochloride solution.

9. After 15 minutes filter the sample through a medium porosity sintered glass crucible and dilute the filtrate to 200 ml into a volumetric flask with 1M NaCl solution.

10. Take a suitable aliquot of the solution (usually 200 ml) and dilute to 500 ml with water.

11. Proceed from this point as in the procedure for water samples, Step 2.

12. Percent solids should be found on all samples so that dry basis concentration can be calculated.

Calculation:

$$\mu g/kg\ Hg_{\text{wet basis}} = O.D. \times \frac{1000}{g.\ sample} \times \mu g/O.D.\ (\text{factor from Standards}) \times \text{dilution factor}$$

$$\mu g/kg\ Hg = \frac{\mu g/kg\ Hg\ \text{wet basis}}{\%\ \text{solids}} \times 100$$

Reporting of Values:

1. From 3/26 to 4/11/70, the lowest reported values were 2, 1, and 0.5 mg/kg; values were dependent on optical density, aliquot of sample and other factors.

2. After 4/11/70, the lowest reported value was 0.5 mg/kg because of standardized conditions such as amount of sample (5 g.) and aliquot of sample (200 ml), and increased sensitivity.

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MERCURY METHOD
Water Samples (Dithizone Method)

Reference: "Colorimetric Metal Analysis," by E. B. Sandell. Pages 621-639. Interscience Publishers, Inc., New York, 1959, 3rd Edition.

Equipment (all glassware rinsed in conc. HNO_3)

1. Liter separatory funnels.
2. Volumetric pipettes (2, 5, 10, 20, 25, 50, and 100 mls).
3. Volumetric flasks (50, 100, 200, 500, and 1,000 mls).
4. Graduate cylinders (50, 100, 250, 500, and 1,000 mls).
5. 30 ml test tubes.
6. Spectrophotometer with 10 mm cells.

Reagents

1. Dithizone working solution, 0.001% (w/v) in analytical-reagent chloroform.* Make up fresh daily.
    a. Make up a stock Dithizone (.1%) solution (.50 g. of Dithizone diluted to 500 ml with chloroform) - keep refrigerated. (Stable for one month.)
    b. 0.001% solution - take 5 ml from stock and dilute to 500 ml with chloroform.
2. Standard mercury solution (keep refrigerated).
    a. Weigh 1.354 g. mercuric chloride.
    b. Dissolve and dilute to 1000 ml with 1N H_2SO_4 (Sol. A); 1.00 ml = 1000 μg Hg.
3. Working mercury solution (make up fresh daily); 1.00 ml = 1 μg Hg.
    a. Dilute 5 ml of standard solution (Sol. A) to 500 ml with 1N H_2SO_4 (Sol. B); 1 ml = 10 μg Hg
    b. Dilute 50 ml from Sol. B to 500 ml with 1N H_2SO_4 (Sol. C); 1 ml = 1 μg Hg

*Chloroform should be of highest purity and should be purchased in glass containers.

Reagents (cont.)

4. 6N Acetic Acid (341 ml glacial acetic acid diluted to 1L with distilled water).
5. 1N H_2SO_4 (28 ml conc. H_2SO_4 diluted to 1L with distilled water).
6. Conc. H_2SO_4.
7. Chloroform

Procedure

1. Dilute to 500 ml, blank and standards(2, 5, and 10 µg Hg in 500 ml H_2O), and pour into 1 liter separatory funnel.
2. Measure an appropriate sized sample, dilute to 500 ml and pour into liter separatory funnel (any residual chlorine must be removed from sample by adding sodium sulfite on a neutralized sample - described in BOD procedure - Standard Methods).
3. Add to each separatory funnel:
    a. 14 ml conc. H_2SO_4 (for bottom sediments, 4 ml if 200 ml aliquot is used).
    b. 40 ml 6N acetic acid.
4. Let cool, then add 5 ml chloroform.
5. Shake the funnels for one minute.
6. Allow to stand until layers separate and carefully withdraw the chloroform layer and discard.
7. Add exactly 10 ml 0.001% dithizone and shake vigorously for one minute.
8. Insert a small amount of cotton into the funnel stem and carefully withdraw the dithizone into clean, dry test tubes.
9. Read, as soon as possible, at 500 mµ on a spectrophotometer with a 10mm light path.

Calculation

$$\mu g/l\ Hg = O.D. \times \frac{1000}{ml\ sample} \times \mu g/O.D.\ (\text{factor from Standards}) \times \text{dilution factor.}$$

Reporting of Values:

From 3/26 to 4/11/70, the lowest reported value was .01 mg/1

From 4/13/70, with increased sensitivity the lowest reported value was .005 mg/1.

MISCELLANEOUS MERCURY ANALYSES IN LAKE ERIE BASIN

As a part of its mercury investigations in the Lake Erie Basin, the FWQA Lake Erie Basin Office has been analyzing bottom sediments from the lower portions of south shore tributaries and from the lake bottom. The purpose is to assist the Basin Office in setting priorities for further testing in areas where contamination may exist. The following tabulations include all sediment tests to date (4/29/70) and tests on water except those made in the area of the Detrex Chemical Corp. plant. Detrex analyses have been listed in a special report on that plant.

At the Lake Erie Basin Office the lower limit of sensitivity on sediment mercury analyses is considered to be 10 mg/kg and on water analyses 10 µg/l. The sensitivity is not considered sufficient for mercury analyses and further refinement of methods is being attempted.

The Ohio Department of Health reports that analyses of 17 intakes in Lake Erie have revealed less than 1 ppb of mercury in each and every case.

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LAKE ERIE BASIN OFFICE

MERCURY ANALYSES - SEDIMENT

Station No.	Location	Date	Mercury* mg/kg
1	0.53 mi. Portage River (Rt. 2 bridge)	4/14	<10
2	0.0 mi. Sandusky River	4/14	<10
3	Tributaries emanating from NASA-Plumbrook		
	PB-1 (Plum Brook)	4/10	<10
	PB-2 (No Name Creek)	4/10	<10
	PB-3 (East Branch, Pipe Creek)	4/10	<10
4	0.61 mi. Black River (Rt. 2 bridge)	4/13	<10
5	8.13 mi. Rocky River	4/22	<10
6	10.0 mi. Rocky River (NASA - Brookpark)	4/14	<10
7	4.27 mi. Cuyahoga River (Norfolk & Western RR bridge)	4/10	<10
8	C33-8 (100 ft. North of Easterly STP outfall)	4/13	<10
9	D24-1 (50 ft. North of E. 222nd St - Babbitt Rd. sewer outfalls)	4/13	<10
10	Tributary to Chagrin River (General Biochemical plant)		
	#1 (200 ft. downstream from plant outfall)	4/10	<10
	#2 (at plant outfall)	4/10	<10
11	2.85 mi. Grand River (St. Clair St. bridge)	4/10	<10
13	0.76 mi. Ashtabula River (East 5th St. bridge)	4/15	<10
14	1.59 mi. Ashtabula River (Norfolk & Western RR bridge)	4/17	<10
15	1.95 mi. Fields Brook (Columbus RR bridge)	4/10	<10
16	No Name Ditch East of Ashtabula (Rt 531 bridge)	4/13	<10
17	J41-1 (Presque Isle Bay)	4/20	<10

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* 10 mg/kg is the lowest sensitivity of test

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LAKE ERIE BASIN OFFICE (cont'd)

MERCURY ANALYSES - SEDIMENT

Station No.	Location	Date	Mercury* mg/kg
18	G33-12 (20 ft. north of Detrex-Linde lakefront outfall)	4/20 4/23	<10 <10
19	G33-13 (80 ft. north of Detrex-Linde lakefront outfall)	4/20 4/23	<10 <10
20	123-2 (6 mi. north of Ashtabula)	4/22	<10
21	H34-2 (6,600 ft., 38°T from Detrex-Linde outfall)	4/22	<10
22	H34-1 (7,000 ft., 35°T from Detrex-Linde outfall)	4/22	<10
23	H33-7 (5,600 ft., 20°T from Detrex-Linde outfall)	4/22	<10
24	5,000 ft. north of Detrex-Linde outfall (H33-8)	4/23	<10
25	3 mi., 56°T from Detrex-Linde outfall (H34-5)	4/23	<10
26	4-3/4 mi., 61°T from Detrex-Linde outfall (H34-6)	4/23	<10
27	2 miles ENE of Conneaut (H36-20)	4/24	<10
28	Mouth of Ashtabula River (A-4)	4/28	<10
29	0.96 miles Ashtabula River (A-3)	4/28	<10
30	600 ft. north of mouth of Grand River (G-5)	4/28	<10
31	0.50 miles Grand River (G-4)	4/28	<10
32	Mouth of Black River (B-4)	4/28	<10
33	1.0 miles Black River (B-3)	4/28	<10

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* 10 mg/kg is the lowest sensitivity of test

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LAKE ERIE BASIN OFFICE (concl'd)

MERCURY ANALYSES - SEDIMENT

Station No.	Location	Date	Mercury* mg/kg
34	37-1/4 mi., 7°T from Cleveland (123-1) Core length		
	0-4 inches	8/20/69	<10
	4-8 inches	8/20/69	<10
	8-12 inches	8/20/69	<10
	16-20 inches	8/20/69	<10
35	Composite of benthic organisms obtained from Kelleys Island Shoal and Starve Island Reef	4/15	<10

---

* 10 mg/kg is the lowest sensitivity of test

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LAKE ERIE BASIN OFFICE

MERCURY ANALYSES - WATER

Station No.	Location	Date	Mercury* mg/l
12	Diamond Shamrock, Painesville		
	Influent	4/10	<.01
	Hydro discharge to Grand River	4/10	.01
	North sewer to Lake Erie	4/10	<.01
14	1.59 mi. Ashtabula River (Norfolk & Western RR bridge)	4/17	<.01
15	1.95 mi. Fields Brook (Columbus Rd. bridge)	4/17	<.01

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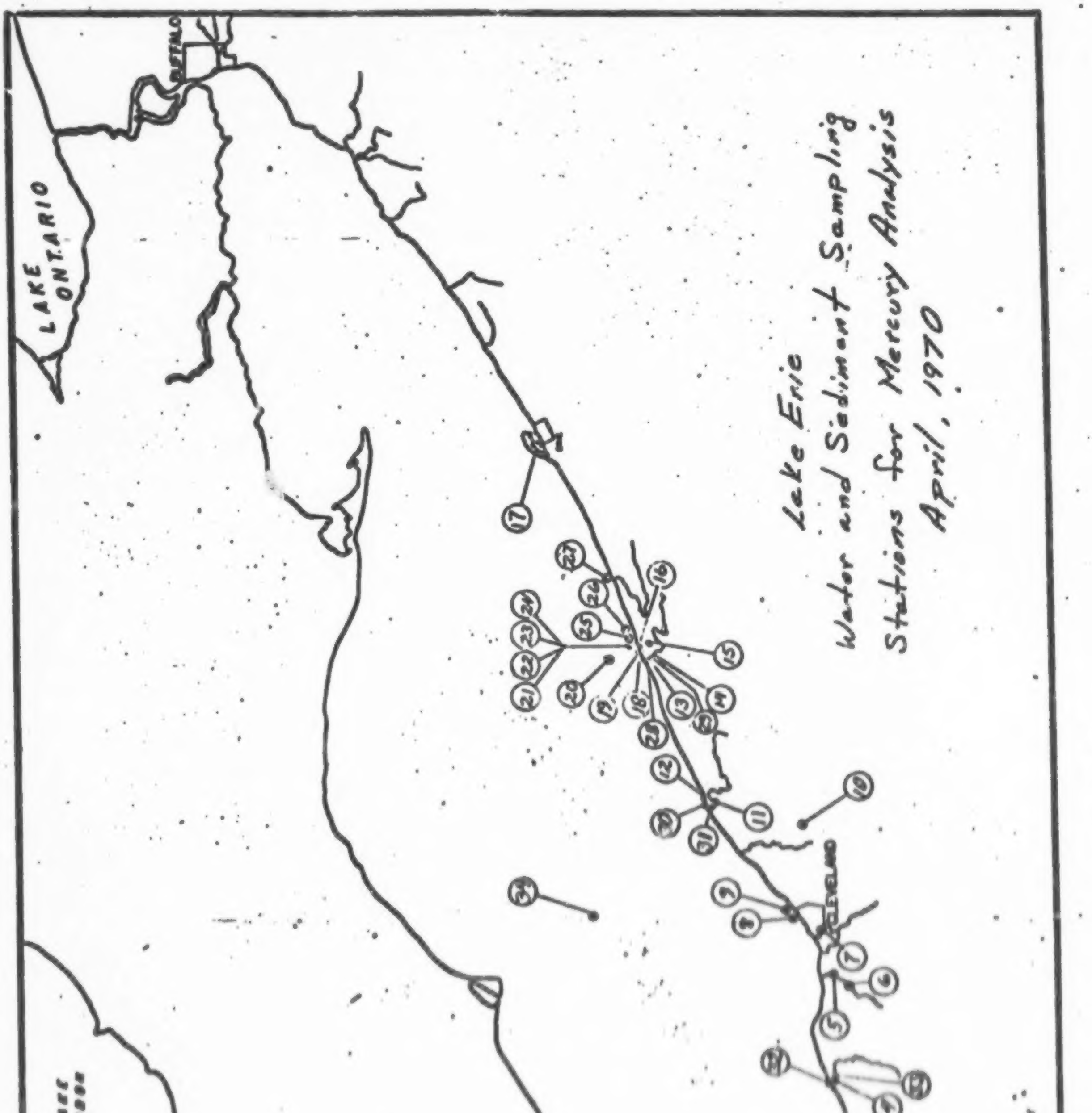
* .01 mg/l is the lowest sensitivity of test


LAKE ONTARIO
BUFFALO
CLEVELAND
DETROIT
LAKE HURON
LAKE ST. CLAIR
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Scale
0 10 20 30 miles

Lake Erie
Water and Sediment Sampling
Stations for Mercury Analysis
April, 1970

PRELIMINARY REPORT ON MERCURY INVESTIGATIONS AT DETREX CHEMICAL CORPORATION, ASHTABULA, OHIO

April 29, 1970

DETREX PROCESS OPERATIONS

Detrex employs the mercury cell in the production of caustic soda (NaOH) and chlorine. In this process brine is decomposed in an electrolysis cell which utilizes mercury as the cathode and graphite as the anode. Chlorine collects at the anode and is led with slight vacuum to the outlet end (upper portion) of the cell. Sodium immediately forms an amalgam with the mercury, the mercury being placed in a thin layer at the bottom of the cell.

The basic reactions involved are:

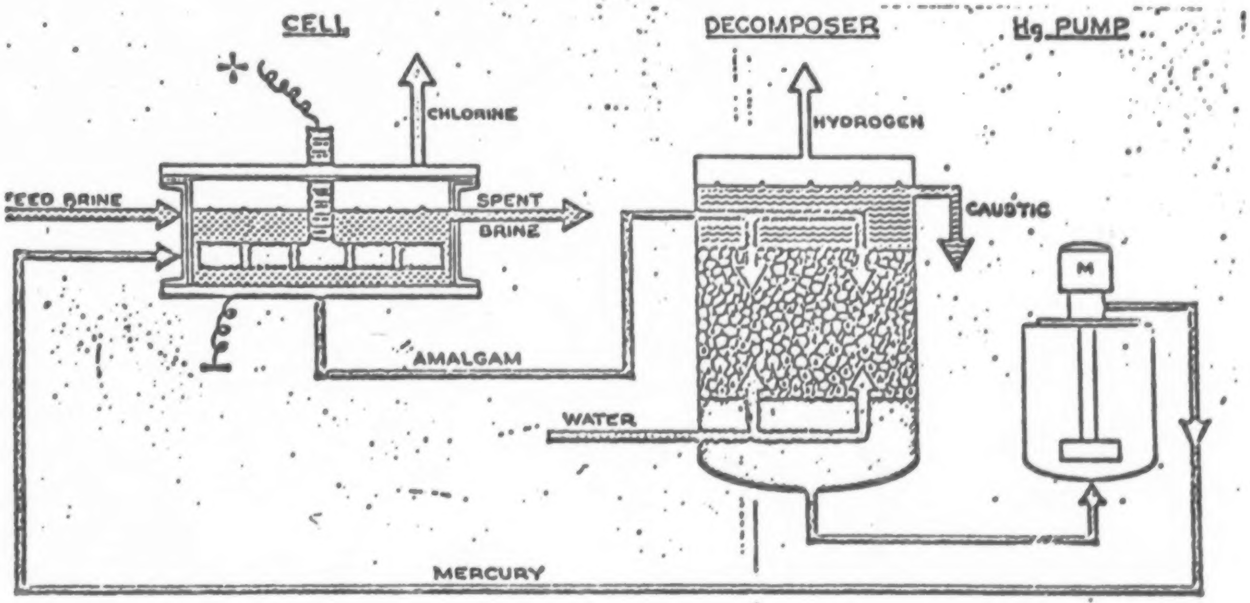
$$2\ NaCl \rightarrow 2\ Na^+ + 2\ Cl^-$$
$$2\ Cl^- \rightarrow Cl_2 + 2e \quad \text{(at graphite anode)}$$

$$2\ Na^+ + 2e \rightarrow 2\ Na \quad \text{(at mercury cathode)}$$

Through an opening at the bottom of the electrolysis cell, the sodium amalgam is directed to a scrubber-like tower (decomposer) where decomposition of the sodium amalgam takes place. The amalgam is introduced from above, through a series of graphite packings. Water is introduced from below and rises counter-current to the amalgam. The amalgam decomposition is effected by the formation of a large number of short circuited cells in which the amalgam and graphite are electrodes and the generated caustic solution is the electrolyte. The reaction which takes place is:

$$2\ Na\ \text{(amalgam)} + 2\ H_2O \rightarrow 2\ NaOH + H_2\uparrow$$

The mercury which is released from the amalgam collects at the bottom of the decomposer where it is withdrawn by a mercury pump and returned to the electrolysis cell. Hydrogen gas, along with traces of mercury vapor, is drawn off through a vent at the top of the decomposer and the caustic solution flows through an exit on the side near the top, as shown in the diagram. Some trace mercury contaminated hydrogen is sold to Linde Welding. The remainder is vented to the atmosphere through steam. Steam minimizes the possibility of fire and explosion.


CELL
DECOMPOSER
Hg PUMP
CHLORINE
HYDROGEN
FEED BRINE
SPENT BRINE
CAUSTIC
M
AMALGAM
WATER
MERCURY

SCHEMATIC DIAGRAM OF A MERCURY CELL

from Blaw-Knox Company -
"The Olin Mathieson Mercury Cell Process"
1963 Form No. 2723 3M

MERCURY LOSSES

According to Detrex at the time of the present investigation (1) there had been no change in recent weeks in the amount of mercury lost in the Chlor-Alkali process, (2) the present loss rate is representative of mercury losses since 1963, and (3) mercury analyses of the discharge effluent have, in the past, been made approximately once per month.

Detrex mercury purchases for electrolysis cell make-up, according to the plant manager, amount to 8-10 flasks per month. One flask of mercury is equivalent to 76 lbs. of mercury (mercury is 13.5 times as heavy as water). Detrex claims that all the 760 lbs. of monthly make-up mercury does not find its way to receiving waters - they claim some of it is pilfered because of its high market value (retail $23 per lb. - Detrex $7 per lb.).

Since March 4, 1970 Detrex has been making frequent analyses for mercury in its waste discharge, sampling at the mouth of a multiple industry used waste water drainage ditch (station No. 4, attached map). Beginning April 17, the Lake Erie Basin Office has sampled daily several sites in the Detrex vicinity including station No. 4, a station (No. 2) in the ditch just below Detrex containing only that company's discharges, and a station (No. 1) at the Detrex sump effluent. The sump effluent is probably the source of most if not all present mercury discharge. Table 1 lists all the mercury analyses to date of samples from the above three stations.

TABLE 1

MERCURY ANALYSES OF DETREX EFFLUENT AND RECEIVING WATERS

Date	Sta. No. 4 Ditch mouth		Sta. No. 2 Ditch below Detrex		Sta. No. 1 Sump effluent	
	mg/l	lbs/day**	mg/l	lbs/day***	mg/l	lbs/day****
3-4-70	0.02	3.9				
3-13-70	0.02	3.9				
3-18-70	0.34	66.2				
3-25-70	<0.02	<3.9				
4-3-70	0.07	13.5				
4-6-70	0.11	21.4				
4-7-70	0.04	7.8				
4-8-70	0.01*	1.9				
4-9-70	0.29*	56.4				
4-10-70	0.01*	1.9	0.13	3.5		
4-17-70	<0.01	<1.9	0.34	9.1	0.07	1.0
4-18-70	0.01	1.9	0.04	1.1	0.02	0.3
4-19-70	0.01	1.9	0.14	3.7	0.11	1.6
4-20-70	0.01	1.9	0.06	1.7	0.09	1.3
4-21-70	0.01	1.9	0.06	1.7	0.05	0.7
4-22-70	0.01	1.9	0.04	1.1	0.05	0.7
4-23-70	<0.01	<1.9	0.04	1.1	0.07	1.0

Underlined analyses by Detrex; all others by LEBO

* Data obtained from Detrex on 4-17-70; data reported earlier by Detrex did not include 4-9-70 analyses and showed <0.01 mg/l for 4-8 and 4-10-70.

** Loadings based upon 23.3 mgd ditch flow which includes flow from Detrex, Linde Welding, and Linde Air.

*** Loadings based upon 3.34 mgd from Detrex only.

**** Loadings based upon 1.87 mgd from Detrex sump effluent only (56% of Detrex total flow)

Data collected by the Lake Erie Basin Office on April 10 and later (Table 1) indicate that discharges to the lake have, in fact, been significantly reduced. Loadings which had previously ranged up to 66 lbs/day have been reduced to less than 2 lbs. per day. However, simultaneous data from the ditch at station No. 2 and at the sump effluent (station No. 1) indicate that mercury still continues to be discharged by Detrex. The data from station No. 2, which one would expect to show intermediate values between those of the sump effluent and the ditch mouth, were in most cases the highest. The anomaly is tentatively explained as being the result of the sampling technique which most likely included some of the "fluffy" sediment from the very shallow ditch waters. The comparatively low concentrations and loadings in the ditch mouth waters indicate that much of the mercury has been settling out in the ditch between Detrex and the lake. Sediment analyses at station No. 2 (see Table 2) show that the ditch sediments do contain significant amounts of mercury.

All mercury in water discharged from the ditch, according to the Ohio Department of Health, is attributable to Detrex since Linde Air and Linde Welding do not use or store mercury on the premises. Analyses of Linde Air and Linde Welding effluents, as listed in Table 2, support that assumption.

Three plants discharge to the waste drainage ditch. The names of those plants and their average flows, according to the Ohio Department of Health, are as follows:

Detrex	3.34 mgd
Linde Air	15.84 "
Linde Welding	4.14 "
Total	23.32 "

On a yearly average, according to the Detrex plant manager, the plant uses 2,750 gallons of water per minute or 3.96 mgd, somewhat higher than the above listed figure. As a result of in-process changes to April 21, 1970, also according to the plant manager, approximately 44% of the total Detrex flow or 1,200 gpm (1.73 mgd) has been removed from the sump, since it is mercury free.

Beginning April 8, 1970, Detrex made a change in discharge practices which it claims is responsible for the low effluent mercury concentrations beginning April 8, 1970. Prior to this time, all Detrex waste waters, including cooling waters, were discharged to the sump preceding the ditch that flows to the lake. The discharge change, claimed by Detrex to have been motivated by economic considerations, involved the removal of some cooling waters from the sump by bypassing the cooling waters through over-sump pipes directly to the ditch. With removal of the cooling waters from the sump, the detention time of the remaining waste discharged to the sump is increased. As a result larger quantities of suspended mercury compounds become settleable and should be removed in the sump.

STATE AND FEDERAL ACTIONS

On April 10, 1970, after the Ohio Health Department had determined that Detrex Chemical Corp. was a probable source of mercury discharge, a visit was made to the plant by Robert Swain, Ohio Department of Health, and Chris Potos, FWQA Lake Erie Basin Office. They met with Robert Baker, (plant manager), Robert Jones, John Kehm, and Dennis Ahistrom of Detrex Corporation. The purposes of this meeting were to learn specifics of the Detrex operation and to determine mercury loss rates, recent changes in the loss rates, and amounts discharged to waters of the state. At that time Detrex had already begun changing its operations to divert "clean" water from its mercury-containing waste flow.

On April 13, 1970 the Ohio Water Pollution Control Board issued a "cease and desist" order to the Detrex Corporation. It contained no time limit for compliance. A copy of this order and the reply to it are attached. The Detrex reply, dated April 17, claimed no mercury discharge to the waters of the state.

On April 17, 1970 Chris Potos and A. R. Winklhofer, FWQA Lake Erie Basin Office, met at Detrex with Messrs. Robert Emmet, Detrex Vice President and Robert Baker, plant manager, and with Mr. Robert Swain of the Ohio Department of Health to determine steps taken by Detrex to eliminate mercury discharges to waters of the State as demanded in the State's Cease and Desist order of April 13, 1970.

According to the plant manager steps taken by Detrex as of April 17 were as follows:

1. Floor washing stopped and all mercury picked up with vacuum cleaner since April 16, 1970.
2. Cell cleaning discontinued April 16, 1970 and no cells have been opened or cleaned since that time.

   Reference to 1. and 2. above--

   Detrex is installing a collecting tank and pump to collect floor water, cell spent brine, cell wash water, and return it to the brine system, at which time cell cleaning will be resumed.
3. Mercury treating has been stopped completely and indefinitely.

Reproduced from best available copy.

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4. The following indirect cooling water streams are bypassing the sump:

    (1) Hydrogen gas cooler - approximately 65 gpm
    (2) Nash pump seal water cooler - approximately 100 gpm
    (3) Brine heat exchanger - 600 gpm

5. Detrex is filtering 50% caustic soda for the scrubber system (hypochlorite)

Detrex is actively engaged in engineering the following changes to:

1. Reroute the brine dechlorination condenser water to bypass the sump - approximately 500 gpm.

2. Provide a sump or catch basin for hydrogen seal pot water, nash pump seal water, etc., which can then be returned to the decomposer feed water.

3. Provide tank, pump piping, etc. to use filtered caustic for neutralizing waste sulfuric acid and chlorine water.

4. Construct a weir in the effluent ditch to measure quantity of flow; can be used also as a sample point.

5. Install caustic filter backwash tank.

Detrex was urgently advised by Mr. Potos on April 17:

1. to cease and desist mercury discharges to Lake Erie immediately

2. that the ditch and the multiple industry-used-settling pond were not to serve as treatment devices for mercury removal. Detrex discharges were to be made free of mercury prior to leaving Detrex property

3. to hire a consulting engineer to build a waste treatment system to permanently free Detrex discharge waters of mercury

4. to keep FWQA and ODH intimately informed through progress reports

On April 21, 1970, Mr. Potos again visited Detrex along with NFIC (FWQA) representatives, Messrs. John Hyland and Laurence Muir, and the Ohio Health Department's Earl Richards, James Shay, and Robert Swain, to further discuss the mercury problem and additional actions to hasten its abatement.

On a yearly average, according to the plant manager, Detrex uses 2,750 gallons of water per minute, with maximum water use occurring in summer. Based on in-process changes to April 21, 1970, approximately 44 percent of Detrex waste water (1,200 gal/min) has been determined by Detrex to be mercury free, and as a result removed from the sump. It is a Detrex objective as of April 21 to recycle waste streams that contain mercury back to the process in an enclosed system if at all possible. Optimum process operations with least possible mercury discharge are expected by Detrex in two to three weeks. If the mercury-laden streams are impossible to recycle, according to Detrex, the sump effluent will be treated as soon as a practical and economically feasible means becomes available. According to Detrex, the best brains in the chlor-alkali industry are working on the problem in a crash-program effort. If this effort does not meet with success, Detrex has agreed to our demand to hire consulting chemists and engineers to solve the problem. Presently this route is not favored by chlor-alkali people since they feel they know more about mercury (production, use, treatment) than any practicing consulting chemist or engineer. The State of Ohio is in complete agreement with Detrex thinking in this respect. Mr. Potos mentioned to them that ion exchange and reverse osmosis are now on a practical state of the art basis.

In an attempt to minimize the effect of expected seasonal increases in precipitation and consequent runoff on ditch sediment resuspension and scouring, Potos suggested that Detrex dredge the ditch from the sump to the settling pond. Detrex exceeded this request by volunteering to excavate a new ditch and complete fill in the old (see map).

During the weekend (April 18 and 19) the settling pond was being given its spring dredging by Linde Welding and the Union Carbide Corp. which owns the entire area and leases segments to various industries. The pond dredging does not seem to have affected mercury concentrations at the ditch mouth approximately one mile distant, at least not through April 20, 1970. Dredgings from the pond are purportedly trucked to State-approved land fill areas according to the Ohio Department of Health.

The Lake Erie Basin Office has sampled stations 1, 2, 3, 4, 5, 7, 8, 9, and 11 daily from April 17 through April 24. Station 11 is influent to the plant. Sampling will continue less frequently after April 24, 1970.

Table 2 lists other miscellaneous mercury sampling analyses in the vicinity of Detrex. At sampling station No. 9, east branch of the ditch, mercury presence is likely the result of back up water from Detrex as there are no known discharges of any kind to this branch.

The samples, both sediment and water, taken by the Lake Erie Basin Office are analyzed colorimetrically by that office using Dithizone with chloroform extraction.

Along with the attached map is a table of Lake Erie Basin Office analyses to date in the Detrex area, (Table 2).

TABLE 2

DETREX AREA MISCELLANEOUS MERCURY ANALYSES

WATER (mg/l) AND SEDIMENT (mg/kg dry)

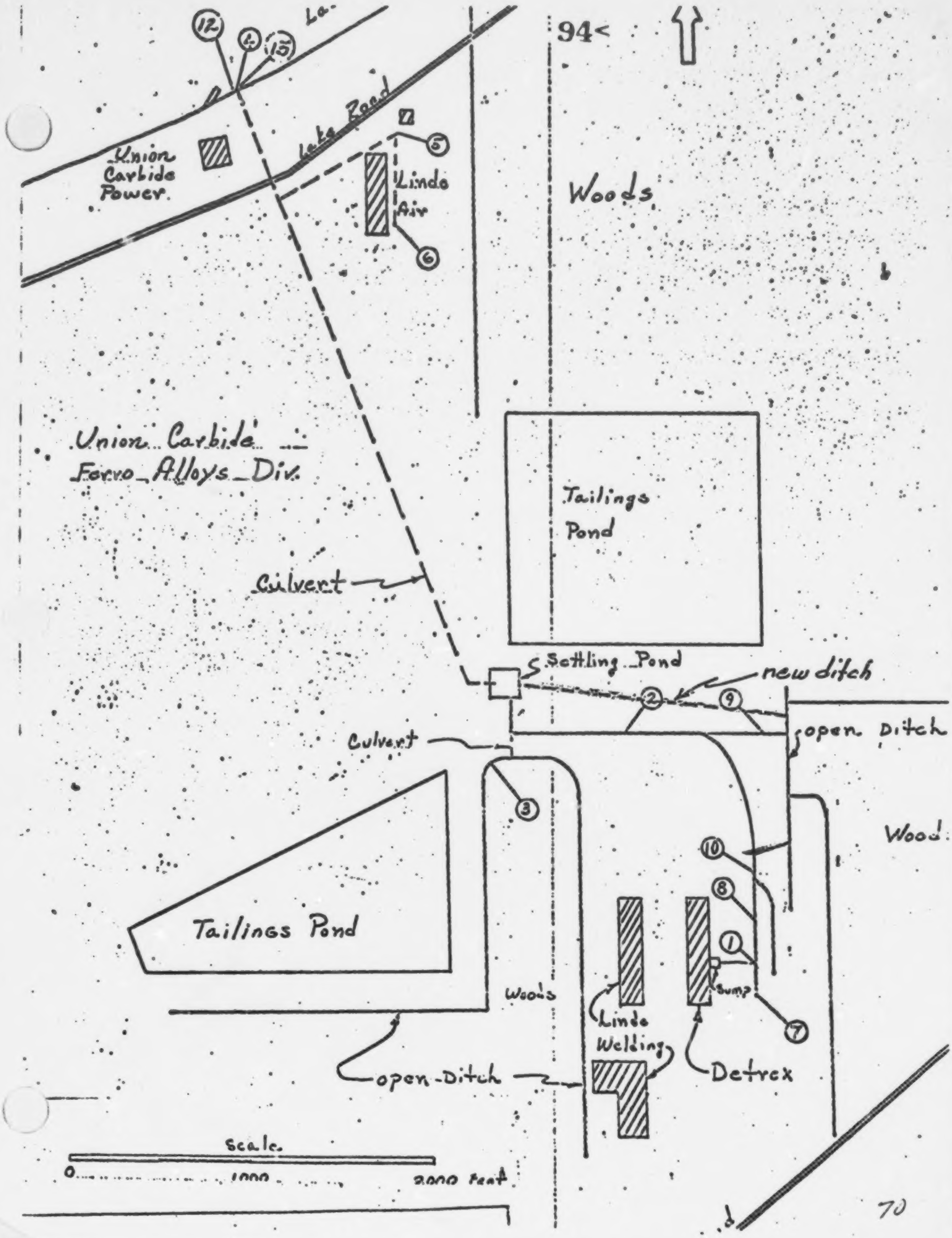
Water Sample

Sta. No.	Station	4/10	4/17	4/18	4/19*	4/20*	4/21	4/22	4/23
3.	Linde Welding	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
5.	Linde Air	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
7.	Caustic Evaporator-Detrex	-	-	0.03	<0.01	0.02	<0.01	<0.01	<0.01
8.	Heat exch-Condenser-Detrex	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
9.	East branch ditch	-	-	<0.01	<0.01	0.02	0.06	<0.01	0.01
11.	Detrex Influent	-	-	<0.01	<0.01	0.02	<0.01	<0.01	<0.01

Sediment Sample

Sta. No.	Station	4/10	4/17	4/18	4/19*	4/20*	4/21	4/22	4/23
2.	Ditch	-	50	170	-				
3.	Linde Welding	-	<10	-	-				
9.	East branch ditch	-		10	-				
12.	20 feet North of ditch mouth					<10			
13.	80 feet North of ditch mouth					<10			

*4/19 precipitation 0.48 inches at Cleveland Weather Bureau
*4/20 precipitation 0.24 inches at Cleveland Weather Bureau


12
4
15
La
Lake Road
Union Carbide Power
5
Linde Air
6
94<
Woods
Union Carbide Ferro Alloys Div.
Culvert
Tailings Pond
Settling Pond
new ditch
2
9
open Ditch
Culvert
3
Wood
10
8
1
Sump
7
Tailings Pond
Woods
Linde Welding
Detrex
open-Ditch
Scale
0
1000
2000 feet

JAMES A. RHODES, Governor

EMMETT W. ARNOLD, M.D.
Director of Health

50 East Town Street
~~P.O. Box 118~~
Columbus, Ohio 43216

State of Ohio 95<

Department of Health

PUBLIC HEALTH COUNCIL
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April 13, 1970

Detrex Chemicals Industries, Inc.
Chlorine-Alkali Plant
P.O. Box 670
Ashtabula, Ohio 44004

Attention: R. L. Baker, Plant Mgr.

Gentlemen:

You are hereby ordered to cease and desist the discharge of liquid industrial waste containing any mecurial compounds to waters of the state.

Any concentrations of mercury in the raw water used in your plant will be taken into consideration in the compliance with the order.

Please advise this office as to your compliance with the above order.

Yours very truly,

E. W. Arnold, M.D.
Director of Health

CERTIFIED MAIL

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RECEIVED

APR 15 1970

DETREX CHEMICAL
INDUSTRIES INC.
CHLORINE ALKALI
PLANT

DETREX CHEMICAL INDUSTRIES, INC.
Chlorine - Alkali Plant
P. O. BOX 670
ASHTABULA. OHIO

April 17, 1970

State of Ohio
Department of Health
450 East Town Street
P.O. Box 118
Columbus, Ohio 43216

Attention: Dr. E. W. Arnold, Director of Health

Dear Sir:

We received, April 15, 1970, your order "to cease and desist the discharge of liquid industrial waste containing any mercurial compounds to waters of the state."

We had previously taken effluent water samples at our discharge into Lake Erie on April 9th and April 10, 1970. Further samples were taken on April 14th and again on April 16th. In addition, lake bottom samples east, north and west of the discharge were taken on April 15th.

Using analysis methods approved by the State of Ohio, we have obtained negative mercury results on each of the above samples.

In accordance with the above analytical results, we state that the Detrex Chemical Industries, Inc. Chlorine-Alkali Plant at Ashtabula, Ohio is not discharging mercurial compounds to waters of the state.

Very truly yours,

DETREX CHEMICAL INDUSTRIES, INC.

Robert L. Baker
Plant Manager

RLB/akv

APPENDIX III

LAKE ONTARIO BASIN OFFICE

MERCURY ANALYSIS - WATER

Stream Stations	Date	Mercury mg/l
Niagara River at mouth	Apr. 9	*
Genesee River at mouth	Mar. 27	*
Oswego River at mouth	Apr. 14	*
St. Lawrence River, Ogdensburg water intake	Apr. 20	*
St. Lawrence River, Thousand Island Bridge	Apr. 20	*
Lake Ontario		
Braddock Bay West of Rochester, NY **	Apr. 29 (Two Samples)	*
Monroe County Water Authority, 8,000 feet from shore West of Rochester, N.Y.	Apr. 29 (Two Samples)	*

Sewage Treatment Plants	Influent	Effluent	
Buffalo Sewer Authority Buffalo, N.Y. Discharges to Niagara River.	*	*	24 Hr. Composite Apr. 27-28
City of Tonawanda, N.Y. Discharges to Niagara River.	*	*	24 Hr. Composite Apr. 27-28
City of North Tonawanda, N.Y. Discharges to Niagara River	*	*	24 Hr. Composite Apr. 27-28
City of Niagara Falls, N.Y. Discharges to Niagara River	0.022 mg/l***	-	Grab Sample Apr. 15 Avg. Flow 75 MGD
" " "	*	-	24 Hr. Composite Apr. 27-28

* <005 mg/l is, the lowest sensitivity of test.

** Sediment sample collected, but not yet analyzed.

*** Based on an average flow of 75 MGD and concentration of 0.022 mg/l. Sewage treatment plant was receiving approximately 13.7 pounds of mercury per day.

APPENDIX IV

BUREAU OF COMMERCIAL FISHERIES

1. Economic Impact of the Current Mercury Pollution Problems in Lakes St. Clair and Erie

2. Mercury in Fish

APPENDIX IV

Economic Impact of the Current Mercury Pollution Problem in Lakes St. Clair and Erie *

Any assessment of the economic cost of the current mercury pollution situation in the Great Lakes must be both tentative and non-quantitative in nature. The actual level of physical risk is not yet determined and political, regulatory reaction has been variable from state to state and subject to continuing revision. The permanence of the impact of this general publicity on the consuming public is also difficult to determine at this point-in-time.

The problem developed just prior to the opening of the commercial fishing season and caught the processing industry with reduced inventories of lake perch and walleye. A very quick and informal survey of the industry reflects that total fish sales from all sources in the Midwest have been reduced about 15 percent since the mercury ban was announced. Although Great Lakes species are not yet back in commercial channels, it is anticipated that Midwest sales of lake perch could be reduced by 50 percent over the course of the 1970 season.

The cost to society is very difficult to define and calculate. The following kinds of cost are, in fact, being incurred and their longer term extent can only be guessed:

(1) Cost of added enforcement, regulation, inspection and control.

(2) Promotional expense by processors, wholesalers, and retailers disassociating ocean species from Great Lakes species.

(3) Cost of holding inventories pending decision.

(4) Cost of subsidies (currently under consideration by the Governor of Michigan for example) to compensate businessmen hurt from either the commercial or sport fish bans.

(5) Loss of revenues to commercial fishermen. Although these businessmen are relatively few in number, the loss to them as individuals is absolute and catastrophic.

(6) Loss to processors and distributors of both Great Lakes and marine fish due to reduced volume. This is particularly significant to processors and distributors in the Midwest since the ban coinsides with the high-volume season.

(7) Loss to producers of ocean fish products to the extent that the total demand for all fish products is reduced by adverse publicity to any single product.

(8) Loss to the consuming public in that their range of choice is effectively reduced by fear of a whole class of food products.

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*by Leo E. Von Wald, Acting Regional Director, Bureau of Commercial Fisheries. Ann Arbor. Michigan. April 30. 1970

In all of these cases, the loss to each level and sector of the economy has "multiplier" impact on many other sectors. It is far too early to anticipate what the net, longer-term economic and social consequence of the mercury pollution problem will be.

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APPENDIX IV

Bureau of Commercial Fisheries
Technological Laboratory
Ann Arbor, Michigan 48107
April 28, 1970

MERCURY IN FISH

Various United States and Great Lakes States agencies are currently investigating the consequences of contamination of the Great Lakes environment by long term mercury spillages that have allegedly resulted from Canadian and U.S. heavy industry operations adjacent to the Great Lakes ecosystem.

One of the actions taken by the Bureau of Commercial Fisheries (BCF), USDI, following the release of information suggesting the relative seriousness of this contamination problem, was to initiate immediate and preliminary monitoring of fish taken from the Great Lakes system for their mercury content. This initial action was based largely on an evaluation of Canadian information concerning concentrations of mercury in fish caught in international waters, as well as on information gained from the literature and public health related agencies. This initial monitoring had as its objectives an assessment of possible direct harm to commercial and sport fishes of the affected areas, as well as the indirect adverse impact that would undoubtedly result to the commercial fisheries from this contamination problem and responses available to the commercial industry. The details of this work and resulting data are being made available on an immediate basis to other agencies of the public sector, recognizing the criteria of evaluation will perhaps differ.

To date, the Ann Arbor, Michigan, Technological Laboratory has been coordinating the BCF collection of appropriate fish samples from the Great Lakes for mercury determinations. Samples have been collected from Lake St. Clair and the

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western basin of Lake Erie. Additional samples are currently being taken from the central basin of Lake Erie, from southern Lake Huron and Saginaw Bay, and from the southeast sector and Green Bay areas of Lake Michigan. Sampling is being performed generally by field staff of the BCF Great Lakes Fishery Laboratory, Ann Arbor, and by field staff of the Michigan Department of Natural Resources, Lansing, Mich.

To the extent possible, approximately 15 individual fish are taken randomly (by trained biologists) by on-site sampling from commercial fishing gear in the immediate area of fishing. Data collected include species, date, location, depth, method of harvest, length and weight (of individual fish), and a scale sample (for subsequent age data). All fish of one lot are separated into "marketable product" (headed, dressed, scaled, tail-off) and "offal" (processing waste). Edible and offal composites (after pooling) are weighed for yield data, ground and sub-sampled for analysis.

Thus far, samples are being analyzed for total mercury content using one or more of several analytical sources. Most of the data has been obtained on samples shipped to Wisconsin Alumni Research Foundation (WARF), Madison, Wisconsin. WARF employs a dithizone extraction of a digested sample coupled with atomic absorption (AA) using a boat technique (Analyst 86, 608 (1961). Some samples are also being examined on a cross-check basis by the Phoenix Memorial Laboratory, The University of Michigan, Ann Arbor, employing a neutron activation (NA) method. This NA data is not available yet, however, or is additional AA data representing samples currently in the hands of WARF. Data acquired to date has been summarized in three consecutively numbered reports (copies attached) dated as follows: (1) 4/15/70; (2) 4/22/70; and (3) 4/24/70.

Attachments (3)

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Bureau of Commercial Fishe
Technological Laboratory
Ann Arbor, Michigan 48107
April 15, 1970

Fish Analyzed for Mercury Content: Report No. 1

Species	Part Analyzed	Code No.	Catch Location	Catch Date	No. fish in Composite	Length ave./range (inches)	Weight ave./range (lbs)	Mercury Content (ppm, wet wt.)	Method
Yellow perch	whole	-	Lake Erie (Wheatley, Ont.)	12/10/69	(500 lbs)	-	-	0.25	atomic absorption
Yellow perch	whole	-	Lake Michigan (Mich City, Ind.)	10/28/69	(550 lbs)	-	-	0.18	atomic absorption
Chub	whole	-	Lake Michigan (South Haven, Mich.)	10/28/69	(600 lbs)	-	-	0.10	atomic absorption
Coho salmon	whole	-	Lake Michigan (Platte River)	11/69	(500 lbs)	-	-	0.30	atomic absorption
Coho salmon	whole	-	Lake Eire (Erie, Penna.)	11/69	(600 lbs)	-	-	0.36	atomic absorption
Carp	edible[1/]	EJG01	Lake Erie (Bono)	4/1/70	10 fish	24.5 22.9-26.8	8.92 6.46-12.76	0.28	atomic absorption
White bass	edible	EPG02	Lake Erie (Bono)	3/30/70	15 fish	10.2 9.0-14.3	0.54 0.32-1.63	0.80	atomic absorption
Yellow perch	edible	EEG02	Lake Eire (Bono)	3/30/70	13 fish	8.46 8.0-9.6	0.30 0.37-0.47	0.44	atomic absorption
Walleye	edible	XNG01	Lake St. Clair (New Baltimore)	3/30/70	5 fish	14.1 12.0-17.6	1.11 0.60-2.11	1.4	atomic absorption
Walleye	edible	XNG02	Lake St. Clair (Pigeon Island) Beach	3/28/70	11 fish	18.9 16.4-20.9	2.87 1.86-3.69	2.0	atomic absorption

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[1/] Headed and gutted, scaled, tail-off.

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Bureau of Commercial Fi[illegible]ies
Technological Laboratory
Ann Arbor, Michigan
April 22, 1970

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Fish Analyzed for Mercury Content: Report No. 2

Species	Part Analyzed	Code No.	Catch Location	Catch Date	No. fish in Composite	Length Ave./range (inches)	Weight Ave./range (lbs.)	Mercury Content (ppm,wet wt.)	Method
Carp	Edible 1/	EJG02	L. Erie (Sandusky, O.)	3/30/70	15	21.5 17.0-25.8	6.25 2.82-10.49	0.08	Atomic Absorption
Yellow Perch	"	EEG01	"	"	16	0.92 0.82-1.08	0.41 0.27-0.66	0.32	"
Coho Salmon	"	EFG01	"	"	14	17.1 14.7-18.9	1.85 1,04-2.51	0.24	"
White Bass	"	EPG01	"	"	15	11.7 9.1-13.8	0.83 0.51-1.46	0.80	"
Channel Catfish	"	EIG01	"	"	13	15.3 13.8-20.0	1.33 0.89-3.08	0.32	"
Sheepshead	"	EOG01	"	"	15	14.9 11.8-19.2	1.56 0.62-3.19	0.24	"
Gizzard Shad	"	EQG01	"	"	16	13.4 11.8-14.3	1.04 0.73-1.84	0.24	"
Sucker	"	XKG01	L. St. Clair (New Baltimore)	4/1/70	3	14.5 11.7-16.8	1.44 0.65-2.23	0.88	"
Northern Pike	"	XLG01	"	"	3	16.9 15.6-18.9	0.95 0.88-1.19	0.64	"
Yellow Perch	"	XEG01	"	"	18	9.72 8.19-12.09	0.45 0.21-0.99	1.10	"

1/ Headed and gutted, scaled, tail-off.

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Bureau of Commercial Fisheries
Technological Laboratory
Ann Arbor, Michigan 48107
April 14, 1970

Fish Analyzed for Mercury Content: Report No. 3 (Cont.)

Species	Part Analyzed	Code No.	Catch Location	Catch Date	No. fish in Composite	Length ave./range (inches)	Weight ave./range (lbs)	Mercury Content (ppm, wet wt.)	Method
N. pike	offal*	XLH01	Lake St. Clair (New Baltimore)	4/1/70	3	16.9 15.6-18.9	0.95 0.88-1.19	0.88	atomic absorption
Walleye	offal*	XNH01	Lake St. Clair (New Baltimore)	3/30/70	5	14.1 12.0-17.6	1.11 0.60-2.11	0.80	atomic absorption
Walleye	offal*	XNH02	Lake St. Clair (Peach Island)	3/28/70	11	18.9 16.4-20.9	2.87 1.86-3.69	1.40	atomic absorption

Edible - Headed and gutted, scaled, tail-off.

Offal - All processing waste from "edible."

* - Denotes the corresponding offal sample for a previously reported edible sample. The third letter in the code No. represents the type of sample; G is "edible," H is "offal."

Bureau of Commercial Fisheries
Technological Laboratory
Ann Arbor, Michigan 48107
April 24, 1970

Fish Analyzed for Mercury Content: Report No. 3 (Cont.)

Species	Part Analyzed	Code No.	Catch Location	Catch Date	No. fish in Composite	Length ave./range (inches)	Weight ave./range (lbs)	Mercury Content (ppm, wet wt.)	Method
N. pike	offal*	XLH01	Lake St. Clair (New Baltimore)	4/1/70	3	16.9 15.6–18.9	0.95 0.88–1.19	0.88	atomic absorption
Walleye	offal*	XNH01	Lake St. Clair (New Baltimore)	3/30/70	5	14.1 12.0–17.6	1.11 0.60–2.11	0.80	atomic absorption
Walleye	offal*	XNH02	Lake St. Clair (Peach Island)	3/28/70	11	18.9 16.4–20.9	2.87 1.86–3.69	1.40	atomic absorption

Edible – Headed and gutted, scaled, tail-off.

Offal – All processing waste from "edible."

* – Denotes the corresponding offal sample for a previously reported edible sample. The third letter in the code No. represents the type of sample; G is "edible," H is "offal."

APPENDIX V

INVENTORY OF INDUSTRIES USING MERCURY

Sources of mercury contamination are chlorine-alkali (chlor-alkali) plants using mercury electrolysis, some vinyl chloride manufacturers, paper mills using mercury slimicides and felt manufacturers. Other operations implicated in mercury contamination are runoff of agricultural mercury-based fungicides, antifouling paint formulations and mercury-containing products for home use.

Chlor-alkali and vinyl chloride plants are most suspect as probable sources of contamination. The possible route of contamination in the chlor-alkali operations is the discharge of brine, that has passed through the cell, into the water. The Japanese incident reported in 1953 involved a vinyl chloride plant using an acelytene process with a mercuric chloride catalyst. The plant was dumping the used catalyst into the nearby bay.

The Food and Drug Administration has developed a list of chlor-alkali plants, vinyl chloride plants and other potential sources to determine levels of mercury residue in sport and commercial fish collected from water into which these sources discharge. FWQA is cooperating with the FDA in these investigations. Table I includes chlor-alkali plants in the Great Lakes Region identified in the FDA listings. No vinyl chloride plants for the Great Lakes Region are identified in the FDA listings. Table II shows other

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operations which are potential sources of mercury contamination. The operations identified in Table II were developed from a listing which indicate they purchased more (+) or less (-) than 15 pounds mercury annually. Basin Offices were directed to contact these industries after investigating the chlor-alkali plants. For the most part, operations listed in Table II show only the name of the industry. Investigation of chlor-alkali plants and other producers, consumers and users of mercury and mercury compounds by the Basin Offices for the Great Lakes Region is continuing.

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TABLE I
INVENTORY OF INDUSTRIES USING MERCURY
CHLOR-ALKALI PLANTS

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Monsanto Co. Sauget, Ill.		Sauget Municipal Treatment Plant	Mercury Cell	Investigation continuing. Sampled b FWQA April 21. Influent and efflue analyses negative. Mercury concent tion in sediment 108 ppm. Company sampled afterwards and confirmed me cury concentrations in influent, ef luent, and bottom sediments.
Wyandotte Chemical Co. Wyandotte, Mich.	80 lbs/day 30,000#/year	Detroit River	Mercury Cell	See Special Report, Appendix III. Have been discharging about 10-20 l per day.
Penwalt Corporation Wyandotte, Mich.	-	Trenton Channel Detroit River	Diaphram Method	Do not use mercury in its operation
Hooker Chemical Co. Montague, Mich.		Lake Michigan	Diaphram Method	Do not use mercury in its operation
Du Pont (Electro Chemicals) Niagara Falls, N.Y.		Niagara River and Niagara Falls STP	Diaphram Method	Do not use mercury in its operation
Olin Mathieson Corp., Chemical Division Niagara Falls, N.Y.	80 lbs./day	Niagara River and Niagara Falls STP	Mercury Cell	Mercury loss to sewers 24 pounds/da based on FWQA and Industry data. Sampled April 17, 1970.
Hooker Chemical Niagara Falls, N.Y.	30 lbs/day	Niagara River	Mercury Cell	Mercury loss to sewer 3.66 pounds/d based on FWQA and Industry data. Sampled April 17, 1970

TABLE I
INVENTORY OF INDUSTRIES USING MERCURY
CHLOR-ALKALI PLANTS

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Allied Chemical Corp. Industrial Chemicals Div. Syracuse, N.Y.		Onondaga Lake and Oswego River	Chlor-Alkali and Potash Plants Mercury Cell	Sampled April 29. Mercury found in split sample by FWQA, but not confirmed by Allied. Further sampling scheduled for May 4, 1970 to reconc differences.
Dow Chemical Midland, Mich.		Tittabawassee River	Diaphram Method	Do not use mercury in its operatio Management reports no mercury consu tion in Michigan plant.
International Minerals and Chemicals - Agricultural Chemicals Division Niagara Falls, N.Y.		Niagara River and Niagara Falls, STP	Chlor-alkali and potash plant. Diaphram Method	Do not use mercury for production.
Stauffer Chemical Co. Niagara Falls, N.Y.		Niagara River	Diaphram Method	Do not use mercury for production.
Detrex Industries Ashtabula, Ohio	9,120 lbs. annually	Lake Erie	Mercury Cell	Management reports Detrex has been purchasing 760 pounds of mercury pe month since 1963 to make up for process losses. See Special Report Appendix III.
Diamond Shamrock Corp., Electro Chemical Division Painesville, Ohio	Not reported	Grand River to Lake Erie	Diaphram Method	Management reports plant is not using or planning to use mercury in its commercial process. Small amou of mercury used for instrumentation Diaphram method for production nof Chlorine and caustic soda does not use mercury. A small amount was us about 2 years ago for two days in a experiment to produce chlorine and caustic soda.

TABLE I
INVENTORY OF INDUSTRIES USING MERCURY
CHLOR-ALKALI PLANTS

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Wyandotte Chemicals Port Edwards, Wisc.	8000-9000 lbs. annually	Wisconsin River	Mercury Cell	Investigation continuing. Effluent and sediment samples collected on April 17, 1970.
Reactive Chemicals Inc. Ashtabula, Ohio	See remarks	Field Brook to Lake Erie	3 plants - 1.Sodium Products 2.Extrusion Products 3.Metals Reduction	Ohio Department of Health reports company does not use or store merc at these plants. Not a Chlor-Alkal plant.

APPENDIX V

ILLINOIS

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Abbott Laboratories 14th & Sheridan St. North Chicago, Ill. 60064	(+) 816#/year	Lake Michigan and No. Shore San. District	Pharmaceuticals	Management reports action will be taken to monitor mercury losses. Approx. 150# unaccounted for annual
Argonne National Labor. 9700 So. Cass Ave. Argonne, Ill. 60440	(+)			
Best Neon Sign Co. 5801 So. Wentworth Ave. Chicago, Ill. 60621	(-) 20#/year		Distributors	Mercury is distributed in prepackag containers.
Celine, Inc. Randall Road St. Charles, Ill. 60174	(+) 25#/year		Distributors	Mercury is distributed in prepackag containers.
Commonwealth Edison Co. 72 West Adams Street Chicago, Ill. 60690	(+)			
A, Daigger, Inc. 159 West Kinzie St. Chicago, Ill. 60626	(+) 300#/year		Distributors	Mercury is distributed in prepackag containers.
Gazzolo Drug & Chem. Co. 117 So. Green St. Chicago, Ill. 60607	(+) less than 100#/year		Distributors	Mercury is distributed in prepackag containers.

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TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

ILLINOIS

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to:	Type of Plant	Remarks
GCA Corp.,Precision Scientific Co. 3737 West Cortland St. Chicago, Ill. 60647	(+)			Do not handle mercury.
D.F.Goldsmith Chemical & Metal Corp. 909 Pitner Ave. Evanston, Ill. 60202	(+) 96,000#/year		Processors at Mercury - Distilling plant	
Goldsmith Bros., National Lead Co. Div. 900 West 18th St. Chicago, Ill. 60608	(+) See Remarks			The Goldsmith Division of National Lead no longer handles mercury.
Harper-Wyman Co. 525 Elm Place Princeton, Ill. 61356	(+) 2000#/year	Domestic wastes to Princeton STP	Manufactures of Mechanical Switches	
Int. Neon & Fluorescent Products 1042 West Madison St. Chicago, Ill. 60607	(+) 25#/year		Neon and Fluorescent products	Mercury distributed in prepackaged containers.
Liquid Carbonic Corp. 135 So. LaSalle St. Chicago, Ill. 60603	(+)		Chemical manufacturers.	Used in monometers only.
Marathon Oil Co. Robinson, Ill. 62454	(+)			

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

ILLINOIS

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Mercoid Corp. 4201 Belmont Ave. Chicago, Ill. 60641	(+) 22,800#/year		Manufacturer of switches.	
Mobil Oil Co. 2000 So. 20th St. East St. Louis, Ill. 62202	(+) 120#/year		Laboratory	Laboratory use approximately 30 lbs Remainder used in flowmeters.
Mt. Vernon Neon Sign Co. Inc. Drawer M Mt. Vernon, Ill. 62864	(+) 741#/year		Manufacturers of Neon signs	
Natl. Electronics Inc. P. O. Box 269 Geneva, Ill.	(+) 21,000#/year	Geneva STP	Electronic Tubes	Mercury not used in chemical proces ing. Placed in tubes in pure state
Neon Accessories Co. 1535 No. Lawndale St. Chicago, Ill. 60651	(+) 60#/year		Neon products	Mercury is distributed in prepackag containers.
Northern Illinois Gas Co. East-West Tollway at Route 59, P.O. Box 190 Aurora, Ill. 60507	(+) 70#/year	LaGrange STP	Natural Gas Suppliers	Used in gas meters.
Rascher & Betzold, Ind. 5410 No. Damen Ave. Chicago, Ill. 60625	(+) 200#/year		Manufacturer of Thermometers	

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

ILLINOIS

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Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Sangamo Electric Co. 1022 Converse Ave. Springfield, Ill. 620702	(+) 1596#/year	Springfield STP	Manufacturers of Electrical equipment.	Contaminated mercury returned to vendor for refining.
E. H. Sargent & Co. 4748 West Foster Ave. Chicago, Ill. 60630	(+)			
D. L. Saslow & Co. 125 No. Wabash Ave. Chicago, Ill. 60602	(+) 2500#/year		Distributor	Mercury is distributed in prepackag containers.
Scientific Prod. Div. 1200 Leon Place Evanston, Ill. 60201	(+) 3000#/year		Distributors to scientific laboratories.	Mercury is distributed in prepackag containers.
L. E. Simmons Refining Co. 7004 So. Normal St. Chicago, Ill. 60616	(+) 36,000	MSD Chicago	Refinery	Spent acids treated to recover precious metals. Waste discharged MSD of Greater Chicago.
Atlantic Richfield Res.Laby. 400 East Sibley Blvd. Harvey, Ill. 60426	(+) 2-300#/year		Laboratory	Mercury used in monometers and gages only.
Standard Scientific Co. 1743 West Rose Hill Drive Chicago, Ill. 60626	(+) 328#/year		Distributors	Mercury is distributed in prepackag containers.
Switch Master Corp. Electronics Center Mt. Carmel, Ill. 62863	(+) 250#/year		Manufacturers of switches.	

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TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

ILLINOIS

Name of Industry Location	Mercury Consumption (Purchased)	Discharged to	Type of Plant	Remarks
Welch Scientific Co. 7300 No. Linder Ave. Skokie, Ill. 60076	(-)		Distributors	Mercury is distributed in prepackag containers.
E. H. Sargeant & Co. 46 Foster Ave. Chicago, Ill. 60630	(+)		Distributors	Mercury is distributed in prepackag containers.

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TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

INDIANA

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Inland Steel Co. Indiana Harbor Works East Chicago, Ind. 46312	(+)			
Northern Indiana Public Service 5265 Hohman Ave. Hammond, Ind. 46325	(+)			
University of Notre Dame Chemistry Department Notre Dame, Ind. 46556	(+) 56#/year	-	University Laboratory	Used mercury is redistilled.
The Adams & Westlake 1025 No. Michigan St. Elkhart, Ind. 46514	(+)			
Durokool, Incorporated 1010 No. Main St. Elkhart, Ind. 46514	(+) 35-40 Flasks/month 2280-3040#/month		Manufacturing mercury switches and relays.	

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

IOWA

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Iowa State College Chemistry Stores Ames, Iowa	(+) 125#/year	Ames STP	Instruments and Laboratory	Mercury losses are buried.
Marshalltown Mfg.Co.Inc. P. O. Box 400 Marshalltown, Ia. 50158	(+) 700#/year	Marshalltown	Temperature Recording Instruments	
State University of Iowa Purchasing Dept. Iowa City, Iowa 52240	(+) 50#/year	Iowa City STP	University Pharmacy and Chemistry Depts.	400 lbs. stolen in 1969.

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

MICHIGAN

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
C & M Pharmical, Inc. 1519 E. 8th & Mile Road Hazel Park, Mich. 48203	(+)			Management reports no mercury purchased for last 9 years.
Carrier-Stephens Co. 221 Depot St. Lansing, Mich. 48903	(+) 61#/year		Chemical distributors.	Distributors of mercury.
Deterich Standard Corp. Ellison Instrument Div. P. O. Box 96 New Buffalo, Mich. 47119	(+) 20#/year	N/A	Manufacturers of Monometers	No mercury wastes.
Detroit Edison Co. 2000 Second Ave. Detroit, Mich.	(+)	Detroit River	Electrical Power Production	Mercury used for switches and gages
Harry W. Dietert Co. 9330 Roselawn Ave. Detroit, Mich. 48204	(+) 50#/year	Detroit STP	Testing equipment and gages.	
General Electric Co. Metallurgical Products Dept. Edmore, Mich. 48829	(+) 3,200	Tittabawassee River. Lagoon to Edmore Municipal STP	Battery Manufacturer	Ordered to cease all discharge o mercury by MWRC on April 16, 197 Company complied with order.
General Motors Corp. AC Sparkplug Div. 1300 No. Dart Highway Flint, Mich. 48506	(+)		Spark plugs and metal castings.	Mercury used in Central Foundry Laboratory equipment and in Laboratory of A. C. plant.

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TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

MICHIGAN

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
W. R. Grace & Co., Veratex Div. 18610 Fitzpatrick Detroit, Mich. 48228	(+)	Detroit STP	Distributor	Repackages mercury and sells to dentists.
G. A. Ingram Co. 4444 Woodward Ave. Detroit, Mich. 48201	(+) 80#/year	Detroit STP	Manufacturers of Instruments for medical profession.	Sell glass vials and one ounce cap to doctors.
Madison Dental Supply Co. 15888 Wyoming Detroit, Mich. 48238	(+) 100#/year	Detroit STP	Distributors of dental supplies.	Repackage mercury and sell to dentists.
H. O. Trerice 1749 Lafayette Blvd. Detroit, Mich. 48216	(+) 1000#/year	Detroit STP	Pressure Gages and equipment.	
Upjohn Co. Kalamazoo, Mich. 49003	(+) 29#/year	Kalamazoo STP	Pharmaceuticals	Used in laboratory gages.

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TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

MINNESOTA

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Fluidyne Corp. 5900 Olson Highway Minneapolis, Minn. 55422	(+)	Septic System	Aerodynomic Testing	Management reports mercury used for instrumentation. No mercury discharged. 2000# of mercury in store or in instruments.
General Refineries, Inc. 292 Walnut St. St. Paul, Minn. 55102	(+)	MSSD	All precious metals refining.	Mercury is refined (3rd distillatio in a closed system. No mercury discharged. FWQA plans to sample MSS primary settling tank.
Hawkins Chemical Co. 3100 E. Hennipin Ave. Minneapolis, Minn. 55413	(+)		Distributor of chemicals,	Stock on hand - 2 pounds.
St. Mary's Hospital 2414 So. 7th St. Minneapolis, Minn. 55406	(-)			
University of Minnesota Minneapolis, Minn. 55455	(+)		Laboratory	Mercury used in instrumentation and laboratory.
W. E. Mowrey 1435 University Ave. St. Paul, Minn. 55104	(+) 2000	MSSD	Dental Metals	Company reaerates and bottles mercur

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TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

MISSOURI

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
White-Rodgers Co. 9797 Reavis Road St. Louis, Mo. 63123	(+)			

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TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

NEW YORK

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Aircraft Turbine Service 1300 Shames Drive Westbury, N.Y. 11590	(-)			
B. O. Kinney, Incorporated Gouverneur, N. Y. 13642	(-)			
Cornell University Scientific Stores Ithaca, N. Y. 14850	(+)			
Faichney Instrument Co. Watertown, N. Y. 13601	(+)			
Henry J. Green Instruments Inc 2500 Shames Drive Westbury, N.Y. 11590	(+)			
International Milling Co. P. O. Box 944 Buffalo, N. Y. 14240	(+)			
J. L. Stortz Company 300 Arsenal St. Watertown, N.Y. 13601	(-)			

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

NEW YORK

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
LAB Corporation P. O. Box G Skaneateles, N. Y. 13152	(+)			
Mobile Oil Company, Inc. R. Bates Buffalo Refinery 635 Elk Street P.O. Box 367 Buffalo, N.Y. 14240	(+)			
Nepera Chemical Company Harriman, N.Y. 10926	(+)			
Primrose-Johnson Dental Co. Inc. 809 Temple Building Rochester, N.Y. 14604	(+)			
Rochester Gas & Electric Corp. 89 East Avenue Rochester, N.Y. 14604	(+)			
Syracuse University Chemical Engineering Dept. Syracuse, N.Y. 13210	(+)			

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TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

NEW YORK

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	~~Type of Plant~~	Remarks
Trico Products Corp. 817 Washington St. Buffalo, N.Y. 14203	(+)			
Vir-Tis Co. Inc. Gardiner, N.Y. 12525	(+)			
Hoover & Strong 119 West Typper St. Buffalo, N.Y. 14201	(+)			
Union Carbide & Carbon Corp. Linde Air Products Div. E. Park Drive & Woodward Ave. Tonawanda, N. Y. 14150	(+)			
Williams Gold Refining Co. Inc. 2978 Main St. Buffalo, N.Y. 14214	(+)			
Xerox Corporation 800 Phillips Road Webster, N.Y. 14580	(+)			

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

OHIO

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Bellows Electric Sign Co. 861 E. Tallmadge Ave. Akron, Ohio 44309	(-)			
Case Western Reserve University Attn: G.J.Kibler, Mgr. of Pur. Dept. 2220 Circle Drive Cleveland, Ohio 44106	(+)			
Lincoln Electric Co. 22801 St. Clair Ave. Cleveland, Ohio 44117	(+)			
National Aeronautics & Space Admin. Lewis Research Center 21000 Brookpark Road Cleveland, Ohio 44135	(+)			
Owens Illinois Glass Co. All Plants Box 1035-1036 Toledo, Ohio 43601	(+)			
Meriam Instrument Co. Div. of Scott & Fetzer Co. 10920 Madison Ave. Cleveland, Ohio	(+)			

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TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

OHIO

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
The Schuemann-Jones Co. 3030 West 117th St. Cleveland, Ohio	(-)			
Standard Oil Co. of Ohio Midland Building Cleveland, Ohio 44115	(+)			
Bailey Meter Company 29801 Euclid Ave. Wickliffe, Ohio 44092	(+)			
General Electric Company Lamp Division Nela Park Cleveland, Ohio 44112	(+)			
Union Carbide Consumer Products Co. A Div. of Union Carbide P. O. Box 2837 Rocky River, Ohio 44116	(+)			

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

PENNSYLVANIA

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
American Meter Company 920 Payne Avenue P. O. Box 1251 Erie, Penna.	(+)			

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

WISCONSIN

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Badger Meter Mfg. Co. Penn Measure - Rite Div. 4545 W. Brown Deer Road Milwaukee, Wisc. 53223	(+) 500#/year	Brown Deer STP	Instruments-water meter.	
Charmin Paper Products Co. Green Bay, Wisc. 54305	(-) 9#/year			
Cutler-Hammer, Inc. P. O. Box 463 Milwaukee, Wisc. 53201	(+)		Instruments	Used in timing instruments.
Dairyland Power Cooperative LaCrosse, Wisc. 54602	(+) 20#/year	Septic Tank	Electric Power	Mercury used in instruments only.
ESB, Inc. (Elec.Storage Battery) Ray-O-Vac.Div. 212 East Washington Ave. Madison, Wisc.	(+) 26,100 #/year	Madison STP	Electric Storage Battery Manufacturer	Investigation continuing .
General Electric X-Ray Dept. 4855 Electric Ave. Milwaukee, Wisc. 53201	(-) 10#/year		Manufacturers of medical equipment.	
Gentec Hospital Supply Co. 250 No. Water St. Milwaukee, Wisc. 53202	(+) 181#/year		Hospital supplies.	Mercury received in 5pound bottles and reshipped in same container without repacking.

TABLE II
INVENTORY OF INDUSTRIES USING MERCURY

WISCONSIN

Name of Industry Location	Mercury Consumption (Purchased)	Discharge to	Type of Plant	Remarks
Hamlin, Inc. Lake & Grove Sts. Lake Mills, Wisc. 53551	(+) 420#/year		Switches	Mercury losses in working areas collected in drip pans and reused.
Institute of Paper Chemistry P. O. Box 148 Appleton, Wisc. 54911	(+) 10#/year		Unsed in instruments.	Management reports that the use slimicides containing mercury was discontinued about 15 years ago.
Milwaukee County General Hospital 8700 W. Wisconsin Ave. Wauwatosa, Wisc. 53226	(+)			
Quade Dental Supply Co. 2309 No. 36th St. Milwaukee, Wisc. 53210	(+) 100#/year		Distributors of dental supplies.	
The Trane Co. LaCrosse, Wisc. 54602	(+)		Air Condition Manufacturing	Mercury is used in switches and i the laboratory.
University of Wisconsin Stores Dept. Madison, Wisc. 53706	(+) 310#/year		Laboratory	

APPENDIX VI

Federal-State Water Quality Standards and USPHS Drinking Water Standards for Mercury and Heavy Metals[1]

All States have adopted general criteria as a part of their water quality standards applicable to all waters which require that waters be free of substances attributable to discharges or wastes which are toxic or which produce undesirable physiological responses in human, fish, and other animal life and plants. Accordingly, mercury as well as other toxic substances would be included in the general criteria.

Specific numerical criteria for toxic substances have been included in water quality standards as follows:

State	Metal	Criteria Values in mg/1	Use Classification to Which Applied
Alabama	No Specific Criteria		
Alaska	USPHS Standards		Water Supply
Arizona	No Specific Criteria		
Arkansas	All Toxic Materials	0.1 48-hr TLm[2]	Fish and Wildlife
California-Sacramento-San Joaquin Delta	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Copper	0.01	Water Supply
	Iron	0,3	Water Supply
	Lead	0.05	Water Supply
	Manganese	0.05	Water Supply
	Silver	0.01	Water Supply
	Zinc	0.1	Water Supply
Colorado River	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Copper	0.05	Water Supply
	Lead	0.05	Water Supply
	Silver	0.05	Water Supply
	Zinc	0.05	Water Supply
Colorado	USPHS Standards		Water Supply
Connecticut	No Specific Criteria		
Delaware	No Specific Criteria		
Florida	No Specific Criteria		

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1/ Heavy metals considered: Cadmium, Chromium, Copper, Iron, Lead, Manganese Silver, Zinc.

2/ The TLm is the concentration of a toxic material which produced death to one-half of the test organisms in a bioassay test within a specified leng of time (eg. 48 hours or 96 hours).

State	Metal	Criteria Values in mg/l	Use Classification to Which Applied
Georgia	No Specific Criteria		
Hawaii	No Specific Criteria		
Idaho	(*Water Quality Criteria*, published by the State of California referenced as a guide)		
Illinois	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Chromium (trivalent)	1.00	Water Supply
	Copper	1.0	Water Supply
	Iron (total)	0.3	Water Supply
	Lead	0.05	Water Supply
	Silver	0.05	Water Supply
	Zinc	5.0	Water Supply
	Cadmium	0.05	Aquatic Life
	Chromium (hexavalent)	0.05	Aquatic Life
	Chromium (trivalent)	1.00	Aquatic Life
	Copper	0.04	Aquatic Life
	Iron	1.00	Aquatic Life
	Lead	0.1	Aquatic Life
	Silver	0.05	Aquatic Life
	Zinc	1.00	Aquatic Life
Indiana	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Lead	0.05	Water Supply
	Silver	0.05	Water Supply
	All Toxic Materials	0.1 96-hr TLm	Fish and Wildlife
Iowa	Cadmium	0.01	Water Supply & Fish and Wildlife
	Chromium (hexavalent)	0.05	Water Supply & Fish and Wildlife
	Lead	0.05	Water Supply & Fish and Wildlife
	Lead	0.10	Fish and Wildlife
	Chromium (trivalent)	1.00	Fish and Wildlife
	Copper	0.02	Fish and Wildlife
	Zinc	1.0	Fish and Wildlife

State	Metal	Criteria Values in mg/l	Use Classification to Which Applied
Kansas	USPHS	Standards	Water Supply
Kentucky	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Lead	0.05	Water Supply
	Silver	0.05	Water Supply
	All Toxic Materials	0.1 48-hr TLm	Fish and Wildlife
Louisiana	All Toxic Materials	0.1 48-hr TLm	Water Supply
Maine	No Specific Criteria		
Maryland	No Specific Criteria		
Massachusetts	No Specific Criteria		
Michigan	Chromium (hexavalent)	0.05	Water Supply
Minnesota	Copper	1.0	Water Supply
	Iron	0.3	Water Supply
	Manganese	0.05	Water Supply
	Zinc	5	Water Supply
	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Lead	0.05	Water Supply
	Silver	0.05	Water Supply
	Chromium	trace	Class A Fisheries & Recreation
	Copper	trace	Class A Fisheries & Recreation
	Chromium	1.0	Class B Fisheries & Recreation
	Copper	0.2	Class B Fisheries & Recreation
Mississippi	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Lead	0.05	Water Supply
	Silver	0.05	Water Supply
Missouri	No Specific Criteria		

State	Metal	Criteria Values in mg/l	Use Classification to Which Applied
Montana	USPHS	Standards	Water Supply
	All Toxic Materials	0.1 96-hr TLm	All Uses
Nebraska	USPHS	Standards	All Uses
Nevada	No Specific	Criteria	
New Hampshire	No Specific	Criteria	
New Jersey	No Specific	Criteria	
New Mexico	No Specific	Criteria	
New York	No Specific	Criteria	
North Carolina	All Toxic Materials	0.0	Water Supply
North Dakota	USPHS	Standards	Water Supply
	Cadmium	0.01	Fish and Wildlife
	Chromium (total)	1.0	Fish and Wildlife
	Chromium (hexavalent)	0.05	Fish and Wildlife
	Copper	0.1	Fish and Wildlife
	Lead	0.05	Fish and Wildlife
Ohio	Cadmium	0.01	Water Supply
	Chromium (hexavalent)	0.05	Water Supply
	Lead	0.05	Water Supply
	Silver	0.05	Water Supply
	Iron(certain Rivers on Ohio/Pa. border only)	1.5	Water Supply
	All Toxic Materials	0.1 48-hr TLm	Aquatic Life and Recreation
Oklahoma	All Toxic Materials	0.1 48-hr TLm	Water Supply
Oregon	Cadmium	0.01	All Uses
	Chromium	0.05	All Uses
	Copper	0.005	All Uses
	Iron	0.1	All Uses
	Lead	0.05	All Uses
	Manganese	0.05	All Uses
	Zinc	0.1	All Uses

State	Metal	Criteria Values in mg/l	Use Classification to Which Applied
Oregon(cont'd)	Heavy Metals (Totals including copper, lead, zinc, and others of non-specific designation)	0.5	All Uses
Pennsylvania	Manganese	1.0	All Uses
	Iron(total)	1.5	All Uses
	Iron dissolved	0.3	All Uses
Rhode Island	No Specific	Criteria	
South Carolina	All Toxic Materials	0.0	Water Supply
South Dakota	USPHS	Standards	Water Supply
	Iron	0.2	Fish and Wildlife
Tennessee	No Specific	Criteria	
Texas	No Specific	Criteria	
Utah	USPHS	Standards	All Uses
Vermont	No Specific	Criteria	
Virginia	No Specific	Criteria	
Washington	USPHS	Standards	All Uses
West Virginia	No Specific	Criteria	
Wisconsin	No Specific	Criteria	
Wyoming	USPHS	Standards	Water Supply
District of Columbia	No Specific	Criteria	
Guam	No Specific	Criteria	
Puerto Rico	No Specific	Criteria	
Virgin Islands	No Specific	Criteria	

	Metal	Criteria Values in mg/l	Use Classification to Which Applied
USPHS Drinking Water Standards	Chromium	0.5	Public Water Supply
	Cadmium	0.01	Public Water Supply
	Copper	1.0	Public Water Supply
	Iron	.03	Public Water Supply
	Lead	.05	Public Water Supply
	Manganese	.05	Public Water Supply
	Silver	.05	Public Water Supply
	Zinc	5.0	Public Water Supply

APPENDIX VII

WATER QUALITY STANDARDS, FEDERAL ENFORCEMENT PROCURES AND THE 1899 RIVERS AND HARBORS ACT

The Water Quality Act of 1965 provided for the adoption of water quality standards for all interstate waters of the United States. Under this law the States adopted water quality standards which were then reviewed and, if found satisfactory, approved by the Secretary of the Interior as Federal standards. Included in the water quality standards are use designations for the interstate waters, criteria designed to protect the designated uses, and a plan of implementation which provides remedial measures to be followed to achieve water quality criteria for such measures. The water quality standards program is a very comprehensive program and is the backbone of the Federal effort for attaining clean water. The Standards facilitate compliance with pollution control requirements by letting water users know in advance, first, what they can expect in the way of water quality and, second, what as users of that water, is expected of them in the way of waste treatment.

Enforcement action through the Enforcement Conference techniques may be initiated to abate pollution of interstate or navigable waters when the pollution of such affects the health or welfare of persons, or when pollution prevents the marketing of shell fish under certain circumstances. There are three distinct stages of such Federal Enforcement Action: Conference, Public Hearing and Court Action. The conference stage is conducted informally. The conferees represent the State Water Pollution Control agencies, Interstate Water Pollution Control agencies, if any, the Department of the Interior. The function of the conference is to inquire into the occurrence of pollution abatable under the Act, the adequacy of the measures being taken, and the nature of the delays being encountered. Agreement of the conferees, if possible, is obtained on a required remedial program to abate the pollution. The remedial program is published by the Secretary.

The second stage, the public hearing is a formal procedure directed toward individual alleged polluters. The Hearing Board is comprised of five or more members, appointed by the Secretary. The findings and recommendations made by the Hearing Board on the basis of theevidence presented are sent to the polluters with a specified time for compliance and to the State and Interstate agencies.

Federal Court action against the polluter by the Attorney General of the United States can be invoked as a final step. In addition to the enforcement conference technique, the Secretary may take direct enforcement action against polluters in the event he determines a violation of Water Quality Standards. Upon the issuance of a 180 day notice of violation of water quality standards, the Secretary may request the Attorney General to commence action against such polluter to abate violation of the standards.

Recently there has been an upsurge of activity related to enforcement of the 1899 Rivers and Harbors Act. This Act prohibits the discharge of any refuse material other than that flowing from streets and sewers into the navigable waters of the nation. The Army Corps of Engineers has the primary responsibility of enforcing this Act by requesting legal action to be taken by the U.S. Attorney.

However, anyone may request the U.S. Attorney to prosecute under this Act. Violations of the Act subject the violator to fines of up to $2,500 and repeated violations may be enjoined.

APPENDIX VIII

THE RESPECTIVE ROLES OF THE STATES AND FEDERAL GOVERNMENTS IN THE ENFORCEMENT OF WATER QUALITY STANDARDS

Federal enforcement actions are intended to encourage State action under State laws and to strengthen the hands of State authorities.

While the Federal role in water pollution control is significant, that role is premised upon cooperation with State and local governments. This fact is emphasized by Congress in the Declaration of Policy of the Act: "It is hereby declared to be the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of the States in preventing and controlling water pollution, to support and aid technical research relating to the prevention and control of water pollution and to provide Federal technical services and financial aid to State and Interstate agencies and to municipalities in connection with the prevention and control of water pollution." The Federal Program is very closely linked with the programs of the States.

Federal enforcement action is not intended to replace State action. States are encouraged to take the lead role in enforcement. In a Federal enforcement conference approach, it would take a minimum of 18 months for the FWQA to bring a polluter into court. Court action could delay the clean-up for several more years. Total time to abate pollution through Federal action alone can be very lengthy. States are not subject to the legal, time limitations that have been placed on Federal Government. A State can insure compliance in a matter of hours in emergency cases and usually within a year to 18 months in routine cases. Often court action is not necessary when the Federal and State governments jointly proceed toward the abatement of pollution. The Federal program is designed to aid and assist the States in abating pollution.

Regulations are also being developed by FWQA for the control of hazardous substances pursuant to section 11 of the Federal Water Pollution Control Act, as amended by the Water Quality Improvement Act of 1970.